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A MULTIVARIATE STATISTICAL ANALYSIS OF SPIRAL GALAXY LUMINOSITIES. I. DATA AND RESULTS

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ABSTRACT

We have performed a multiparametric analysis of luminosity data for a sample of 234 normal spiral and irregular galaxies observed in X-rays with the *Einstein Observatory*. This sample is representative of S and Irr galaxies, with a good coverage of morphological types and absolute magnitudes. In addition to X-ray and optical data, we have compiled H-band magnitudes, *IRAS* near- and far-infrared, and 6 cm radio continuum observations for the sample from the literature. We have also performed a careful compilation of distance estimates. We have explored the effect of morphology by dividing the sample into early- (S0/a–Sab), intermediate- (Sb–Sbc), and late-type (Sc–Irr) subsamples. The data were analyzed with bivariate and multivariate survival analysis techniques that make full use of all the information available in both detections and limits. We find that most pairs of luminosities are correlated when considered individually, and this is not due to a distance bias. Different luminosity-luminosity correlations follow different power-law relations. Contrary to previous reports, the L_X-L_B correlation follows a power law with exponent larger than 1. Both the significances of some correlations and their power-law relations are morphology dependent. Our analysis confirms the "representative" nature of our sample, by returning well-known results derived from previous analyses of independent samples of galaxies (e.g., the L_B-L_H, L_{12}-$L_{\rm FIR}$, and $L_{\rm FIR}$-$L_{6\,\rm cm}$ correlations). Our multivariate analysis suggests that there are two fundamentally strong correlations, regardless of galaxy morphology, when all the wave bands are analyzed together with conditional probability methods. These are the L_B-L_H and the L_{12}-$L_{\rm FIR}$ correlations. As it is well known, the former links stellar emission processes and points to a basic connection between the initial mass function of low-mass and intermediate- to high-mass stars. The latter may be related to the heating of small and larger size dust grains by the same UV photon field. Other highly significant "fundamental" correlations exist but are morphology dependent. In particular, in the late sample (Sc–Irr) we see an overall connection of mid-IR, far-IR, and radio continuum emission, which could be related to the presence of star-forming activity in these galaxies, while in early-type spirals (S0/a–Sab), we find no strong direct link of FIR and radio continuum. This paper gives a compilation of both input data and results of our systematic statistical analysis, as well as a discussion of potential biases. Results relevant to both X-ray and multiwavelength emission properties are analyzed further and discussed in Paper II.

Subject headings: galaxies: photometry — galaxies: spiral — methods: statistical — radio continuum: galaxies — X-rays: galaxies

On-line material: machine-readable tables

1. INTRODUCTION

Understanding the structure, formation, and evolution of galaxies is one of the main themes of present-day astrophysics. This quest is made difficult by the complexity of galaxies, their interactions with their environment, and our limited knowledge of their observational characteristics (see Gallagher & Fabbiano 1990). While most of the studies of galaxies make use of individual energy bands, chiefly the optical, but also the radio, and more recently the X-ray and infrared (IR), it is rarer to find work comparing data from two or more emission windows. Yet, when this is done, interesting insights may follow. For example, the comparison of H-band and B-band photometry led to the discovery of the well-known color-magnitude relation for spiral galaxies (Aaronson, Huchra, & Mould 1979; Tully, Mould, & Aaronson 1982), a nonlinear correlation between L_B and L_H. The comparison of *IRAS* far-IR and radio continuum data led to the discovery of the well-known strong correlation and to the convincing association of the radio continuum emission with the star-forming stellar population (Dickey & Salpeter 1984; Helou, Soifer, & Rowan-Robinson 1985; de Jong et al. 1985); comparison of CO, Hα, and IR data led to constraints on star formation efficiencies in spirals (e.g., Young 1990); and comparison of multiwavelength data, including X-rays, in late-type spirals suggested the prevalence of intrinsically obscured compact star-forming regions in higher luminosity galaxies (Fabbiano, Gioia, & Trinchieri 1988; Trinchieri, Fabbiano, & Bandiera 1989).

In this paper we report the statistical analysis of the sample of 234 "normal" spiral and irregular galaxies observed in X-rays with the *Einstein Observatory* (Giacconi et al. 1979), as reported by Fabbiano, Kim, & Trinchieri (1992, hereafter FKT92). The present work complements the papers on the statistical analysis of the 148 E and S0 galaxies from FKT92 (Eskridge, Fabbiano, & Kim 1995a, 1995b, 1995c) and completes the statistical analysis of the FKT92 sample. Previous exploratory work on spiral and irregular galaxies (Fabbiano & Trinchieri 1985; Fabbiano et al. 1988; see Fabbiano 1990) was based on a much smaller sample of 51 galaxies. For the purpose of the present work, we have augmented the data presented in FKT92 (X-ray and optical) with *H*-band, mid- and far-IR (*IRAS*), and 6 cm radio continuum magnitudes and flux densities from the literature. This gives us representative coverage over the entire electromagnetic emission spectrum of spiral galaxies and allows us to explore the full range of emission processes and the interaction of different galactic emission components. These phenomena include direct or reprocessed stellar emission (optical and IR); emission from the evolved component of the stellar population, hot interstellar medium (ISM), and nuclei (X-rays); synchrotron emission of cosmic-ray electrons interacting with the galactic magnetic fields; and thermal emission of $\sim 10^4$ K warm ISM (radio continuum). These different emission bands have different sensitivities to absorption, and their comparison may also give us some insight on the dust content of the emitting regions (e.g., Palumbo et al. 1985; Fabbiano & Trinchieri 1987).

The size of the FKT92 sample of spiral and irregular galaxies allows us to explore the dependence of these processes on galactic morphology, one of the key parameter axes in spiral galaxies (Whitmore 1984). Such a dependence was suggested by earlier work (Fabbiano & Trinchieri 1985; Fabbiano et al. 1988), but those results were based on much smaller samples. Here we analyze separately bulge-dominant (S0/a–Sab), intermediate-type (Sb–Sbc), and late-type (Sc–Irr) galaxies; we then intercompare these results and compare them with those of the entire sample.

This is the first paper of a two-paper series. In this first paper we describe the sample and the data analysis, report the results of the analysis, and discuss the possible effects of selection biases. In the companion paper (G. Fabbiano & A. Shapley 2001, in preparation, hereafter Paper II) we look in detail at the astrophysical significance of the results, and we compare our results with those of other related work.

2. THE SAMPLE

The sample used for the statistical analysis consists of 234 spiral and irregular galaxies belonging to the FKT92 sample. As described in FKT92, it consists of relatively nearby galaxies, all observed with *Einstein.* This was the first sample of galaxies ever to be observed in X-rays and was mostly assembled to be a representative (optically selected) sample of normal galaxies, spanning the full range of morphologies and luminosities. To reduce selection biases, FKT92 used the RSA (Sandage & Tammann 1987) and RC2 (de Vaucouleurs, de Vaucouleurs, & Corwin 1976) as basic selection catalogs, by adding to the sample all RSA/RC2 galaxies present in the regions of the sky observed with *Einstein* included in the catalog. Figure 1 shows the histogram of absolute magnitudes of our sample. It compares well with the corresponding histogram from the RSA.

The FKT92 sample includes galaxies of all morphological types. Figure 2 shows the distribution of morphologies

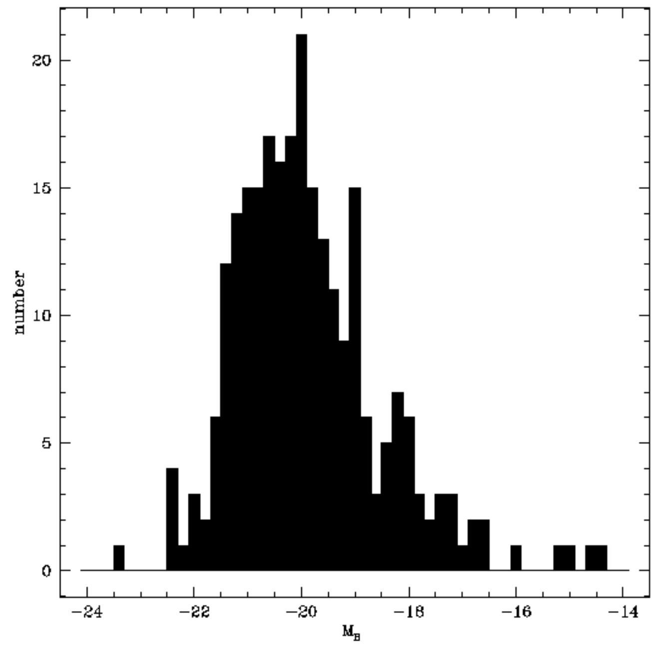


FIG. 1.—Distribution of absolute magnitudes for the sample galaxies

in the spiral sample. All types from S0/a ($T = 0$) to Irr ($T = 10$) are represented. For the purpose of our analysis, besides considering the entire sample of 234 spiral and irregular galaxies, we also divided the sample into three morphological subsamples: the "early" sample, $T = 0$–2 (58 S0/a–Sab and seven amorphous); the "intermediate" sample, $T = 3$–4 (Sb–Sbc, 62 galaxies); and the "late" sample, $T = 5$–10 (Sc–Irr, 107 galaxies). Since the early sample in this definition would include seven amorphous galaxies (see § 3), we further excluded these galaxies. So defined, these subsamples are representative of bulge-

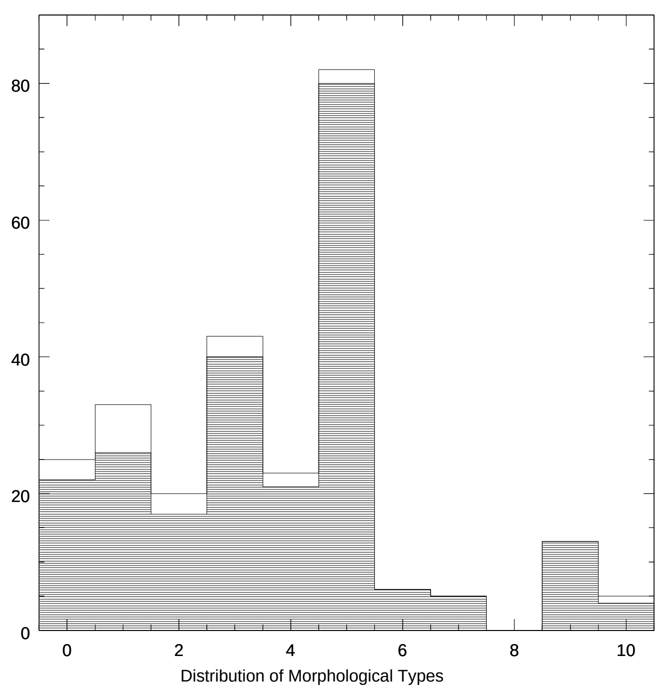


FIG. 2.—Distribution of sample galaxies in morphological types (T). The unshaded regions denote the galaxies flagged as AGNs.

dominant systems, bulge/disk systems, and disk/arm-dominant systems, respectively. Dividing the sample according to morphology is motivated by earlier results that have suggested that the multiwavelength statistical properties of spiral galaxies are morphology dependent (Fabbiano & Trinchieri 1985; Fabbiano et al. 1988).

The FKT92 spiral sample includes a number of active galactic nuclei (AGNs). Twenty of these are X-ray bright powerful Seyfert galaxies and were identified as such in FKT92. The nuclear X-ray source in these galaxies totally dominates the X-ray emission, which is then the expression of the AGN and cannot give us any useful indication on the general "normal" X-ray–emitting population. We have excluded galaxies flagged as AGNs by FKT92 from our analysis, but they are included in some of the figures. However, more recent work with more sensitive data has revealed that nuclear activity, once thought to be an extraordinary phenomenon, is instead rather ubiquitous, albeit at a very low level (Ho, Filippenko, & Sargent 1997). The separation of AGNs from "normal" galaxies becomes then a philosophical issue in the case of low-luminosity activity. Since most bulge galaxies may host nuclear massive black holes (e.g., Magorrian et al. 1998), undetected nuclear activity is always possible. We have retained in our working sample 51 galaxies found by Ho et al. 1997 to have some indication of nuclear activity in their optical spectra. These include 19 low-luminosity Seyfert nuclei, as well as LINERs and nuclei with spectra intermediate between H II regions and LINERs (transition objects). Typically their nuclear X-ray source, based on the cases in which high enough resolution is available (e.g., FKT92), is just one of several identifiable components in the (0.2–4) keV *Einstein* band. More recent *ROSAT* observations (with 5″ resolution) of face-on spiral galaxies show that near-nuclear relatively bright ($L_X \sim 10^{37}$–10^{40} ergs s^{-1}) sources are rather common, but their nature is not clear: they may be low-luminosity AGNs, or bright black hole binaries, or bright young supernova remnants (SNRs) (Colbert & Mushotzky 1999). Therefore, we do not find it justifiable to single out these galaxies. However, there may be energy bands where these faint nuclei may dominate, and this is discussed in Paper II.

The FKT92 sample is neither X-ray selected nor statistically complete: it is not volume or flux limited. Therefore, it cannot be used to derive X-ray luminosity functions of spiral galaxies. However, as long as the sample is representative of the range of morphological types and covers a fair range of galaxy luminosities, it can be used for studying the relations among different emission bands in galaxies. To check for possible peculiarities, it is important to compare our results with analogous results from independent studies, using different "representative" samples chosen for different purposes with different criteria. Discrepancies may indicate that one of these samples may not be indeed representative of the population that it is intended to study (that of spiral and irregular galaxies) and may indeed suffer from peculiar selection biases. For this type of comparison it is particularly important to look at the overall multiwavelength spectrum of correlations and see if we retrieve some of the well-known (non–X-ray) results that have been found from separate, independent studies. This type of comparison is pursued here and is discussed in greater detail in Paper II. We show there that our results are in agreement with well-known IR-optical-radio relationships in spirals and that, therefore, ours is a fair sample for this type of study.

3. THE DATA

Table 1 lists the galaxies (including the AGNs, which are flagged), their coordinates, morphological types (T), distances, X-ray fluxes, optical (B) and near-IR (H) magnitudes, *IRAS* and radio continuum flux densities, and sources for the entries. In the case of nondetections, 3 σ upper limits are given. Additional information on the H-band data is given in Table 2. The variables used for the statistical analysis consist of the logs of the luminosities calculated from Table 1 and are listed in Table 3.

Details on Table 1 and on the derivation of Table 3 entries are as follows.

1. Type (T). The galaxies in our sample range in morphological type from $T = 0$ to 10, corresponding to Hubble types from S0/a to Irr, as listed in FKT92. The sample also includes seven $T = 0$ galaxies with irregular morphology. These are indicated by an "A" (amorphous; Sandage & Tammann 1987) in the T column.
2. Distance (D). We have performed a thorough literature search for distance information for our sample. Thus, the distances in Table 1 differ from those in FKT92, which were derived from Tully (1988) for $H_0 = 50$ km s^{-1} Mpc^{-1}. Details are given in Appendix A.
3. X-ray flux (f_X). X-ray data (0.2–4.0 keV fluxes or 3 σ upper limits) were taken from FKT92.
4. Optical magnitudes (B). Optical, extinction-corrected, and inclination-corrected (B-band) magnitudes are from the Third Reference Catalogue of Bright Galaxies (RC3; de Vaucouleurs et al. 1991). They were converted to fluxes in the B band, following Allen 1973: $f_B = 990 \times 10^{-0.4B-8.17}$.
5. Near-infrared 1.65 μm magnitudes (H). To obtain near-infrared (H-band, 1.65 μm) data for as many galaxies in the sample as possible, we looked in the Catalogue of Visual and Infrared Photometry of Galaxies from 0.5 to 10 μm (de Vaucouleurs & Longo 1988), which contains near-infrared measurements of galaxies and references from the literature from 1961 to 1985. We found photometry data for 159 *Einstein* galaxies (140 normal and 19 flagged as AGNs) from the references listed in the Catalogue.

The H-band data were collected from a number of different sources in the literature, and therefore the idiosyncrasies of the various sources of data needed to be reconciled. First, different aperture-to-diameter ratios were used for various galaxy measurements, i.e., a smaller aperture-to-diameter ratio samples a smaller fraction of the galactic total near-infrared magnitude. Also, several near-infrared filter systems are represented by the full set of H measurements. These systems have slightly different zero points for the conversion from magnitudes to fluxes and slightly different central wavelength and bandwidths. Since the differences in aperture-to-diameter ratio and filter system cause systematic offsets among the near-infrared data and tend to increase the scatter in correlations, the data must be corrected before it can be used for statistical analysis.

To correct the data to a consistent aperture system, we turned to the work of Tormen & Burstein (1995). In an effort to recalibrate the near-infrared Tully-Fisher relationship, Tormen & Burstein (1995) normalize a data set of H-band aperture magnitudes from 1731 galaxies collected over a 10 yr period by Aaronson and collaborators. The

TABLE 1

FLUX DATA

Name	R.A. (1950)	Decl. (1950)	T	Dist. (Mpc)	f_X[a] (10^{-13} cgs)	B (mag)	H (mag)	$f_{\nu(12)}$[a] (mJy)[b]	$f_{\nu(25)}$[a] (mJy)[b]	$f_{\nu(60)}$[a] (mJy)[b]	$f_{\nu(100)}$[a] (mJy)[b]	$f_{\nu(6\ cm)}$[a] (mJy)	Refs.
NGC 0125	00 26 16	02 33 42	0	73.20	<4.28	13.22	...	...	...	...	...	<60	1
NGC 0224	00 40 00	40 59 42	3	0.77	500.	3.36	0.47	160[b]	110[b]	540[b]	2930[b]	2460	2, 3, 4, 5
NGC 0247	00 44 40	−21 02 00	5	3.00	13.71	8.93	7.31	<120	<160	7930	27320	...	3, 5
NGC 0253	00 45 08	−25 33 42	5	3.10	68.81	7.09	4.24	60[b]	160[b]	1000[b]	1860[b]	2080	5, 6, 7
SMC	00 51 00	−73 06 00	9	0.06	2105.	2.28	...	70[b]	270[b]	6690[b]	15020[b]	...	2, 3
NGC 0309	00 54 13	−10 11 18	5	77.10	<2.87	12.11	...	<260	<320	1940	6320	...	6
I1613	01 02 13	01 51 00	10	0.76	21.95	9.82	...	<60	<140	1420	3690	...	3, 8
NGC 0449	01 13 19	32 49 30	5	67.80	<4.77	14.45	12.62	<1790	800	2300	2850	28	6, 9, 10
NGC 0520	01 22 00	03 31 53	0	37.80	<3.06	11.77	8.98	780	2830	31520	48400	72	5, 6, 11
NGC 0521 [c]	01 22 00	01 28 12	5	69.30	<4.39	12.29	...	<800	<340	540	3450	...	6
NGC 0524 [c]	01 22 10	09 16 42	0	34.80	7.01	11.17	8.05	230	<147	780	1820	4.1	12, 13, 14
NGC 0523	01 22 30	33 46 00	10	66.80	<2.49	12.43	10.32	<250	270	2050	4700	<18	5, 6, 15, 16
NGC 0578	01 28 05	−22 55 30	5	22.30	<3.46	11.17	9.46	230	<320	3070	12550	...	5, 6
NGC 0598	01 31 03	30 23 53	5	0.84	210.00	5.75	4.00	30[b]	40[b]	420[b]	1260[b]	1300	2, 3, 4, 5
NGC 0625	01 32 55	−41 41 24	0	4.90	<2.84	11.21	...	<260	900	5660	8700	...	6
NGC 0628	01 34 01	15 31 36	5	7.30	3.39	9.76	7.77	2070	1900	20860	65640	38	3, 5, 17
I1727 [c]	01 44 40	27 05 06	9	7.60	<2.05	11.33	...	<250	<250	390	1890	...	6
NGC 0672	01 45 05	27 11 06	5	7.90	<2.14	10.50	...	<250	370	3370	8340	<4.8	6, 18
NGC 0772 [c]	01 56 35	18 46 00	3	32.80	<6.04	10.55	7.91	290	530	4950	21660	27	4, 5, 6
NGC 0871	02 14 27	14 19 00	5	52.20	<2.51	13.04	...	<250	310	3880	7550	41	6, 17
NGC 0877	02 15 16	14 18 53	5	54.50	2.37	11.96	9.68	370	550	9050	24370	40	4, 6, 19
NGC 0936	02 25 05	−01 22 42	0	19.30	4.35	10.98	7.74	<70	<135	<132	<270	3.7	5, 12, 20
NGC 0941	02 25 55	−01 22 30	6	22.90	<14.90	12.67	...	<250	<250	830	2530	...	6
NGC 0945	02 26 10	−10 45 36	5	60.70	<1.61	12.60	...	<250	<250	950	3810	...	6
NGC 0985 [d]	02 32 11	−09 00 18	10	173.30	200.75	13.89	...	<270	550	1440	2000	...	6
NGC 1042	02 37 56	−08 38 47	5	19.20	5.78	11.36	...	<250	<260	1190	6560	...	6
NGC 1068 [d]	02 40 07	−00 13 30	3	16.50	206.50	9.47	6.04	40[b]	90[b]	190[b]	240[b]	2190	5, 6, 16
NGC 1073	02 41 05	01 09 53	5	17.60	3.82	11.36	...	<250	<250	1150	6050	110	6, 7, 8
NGC 1087	02 43 52	−00 42 30	5	21.50	<7.13	10.97	...	590	830	9270	29550	45	6, 21
NGC 1090	02 44 01	−00 27 23	5	38.10	<4.29	11.83	9.73	<250	<330	870	3780	...	5, 6
NGC 1097	02 44 11	−30 29 06	4	16.50	30.30	9.92	6.79	2880	7700	46730	116340	130	3, 7, 14
NGC 1218 [d]	03 05 49	03 55 12	0	116.60	25.84	13.16	10.34	<80	110	<72	420	<3000	12, 22, 23
NGC 1300	03 17 25	−19 35 30	3	20.80	1.65	10.77	8.76	<250	<300	2410	11180	...	5, 6
NGC 1313	03 17 39	−66 40 42	5	4.50	18.91	9.29	...	950	3490	35970	92000	59	3, 7
NGC 1317	03 20 51	−37 16 53	1	18.40	<2.66	11.81	...	280	270	3690	9530	...	12
NGC 1350	03 29 10	−33 47 54	1	18.40	<4.77	10.87	8.05	<250	<250	<570	3970	...	5, 6
NGC 1358 [c]	03 31 11	−05 15 23	1	54.10	1.40	12.70	9.70	<82.86	<123.6	378	925	1.2	14, 24, 25
NGC 1365	03 31 42	−36 18 17	3	18.40	17.12	9.93	6.84	4420	13070	84200	185400	210	3, 5, 7
NGC 1380	03 34 31	−35 08 23	0	15.80	6.84	10.92	7.65	170	70	1070	3060	1.9	12, 13, 26
NGC 1386	03 34 52	−36 09 53	1	18.40	5.97	12.12	8.79	530	1500	5650	8890	30.0	12, 20, 27
NGC 1398	03 36 45	−26 29 53	2	18.00	3.60	10.39	7.09	<250	<250	930	7820	...	5, 6
NGC 1421	03 40 09	−13 38 54	5	27.80	6.41	11.00	9.37	370	400	7440	21790	...	5, 6, 8
I0342	03 41 57	67 56 24	6	3.60	49.27	6.04	5.73	23660	45200	255960	661680	80	3, 28, 29
NGC 1512	04 02 16	−43 29 12	3	10.20	<3.71	10.96	8.59	<400	<250	890	1130	<12.6	30, 31, 32
NGC 1533	04 08 50	−56 15 00	0	15.50	2.76	11.74	...	<93	60	330	1240	<26.4	12, 33
NGC 1559	04 17 01	−62 54 17	5	16.00	9.80	10.81	8.83	890	1650	23830	58330	120	5, 6, 7
NGC 1566 [d]	04 18 53	−55 03 24	5	15.50	82.68	10.16	7.39	530	890	12700	42200	76	5, 6, 7
NGC 1569	04 26 05	64 44 24	9	1.70	19.31	9.42	8.23	680	6840	46680	51710	278	6, 16, 34
NGC 1614	04 31 36	−08 40 54	5	63.40	6.50	13.28	10.31	1380	7550	33540	32380	...	6, 27
NGC 1625	04 34 35	−03 24 12	4	62.60	<2.77	12.08	...	<250	<250	1070	3740	...	6
NGC 1672	04 44 58	−59 19 36	3	15.30	7.65	10.25	7.97	1470	4030	34800	69460	100	6, 7, 14
NGC 1784	05 03 07	−11 56 24	4	30.10	<2.62	11.63	9.07	<250	<350	2440	9300	...	5, 6
LMC	05 24 00	−69 48 00	9	0.05	8563.	0.57	...	2780[b]	7820[b]	82920[b]	184690[b]	...	2, 3
NGC 1961 [c]	05 36 34	69 21 17	3	75.40	2.77	11.01	8.34	510	470	6600	22070	64	5, 6, 18
U3691	07 05 06	15 15 00	6	28.90	<3.48	11.43	11.38	<250	<250	1360	3790	...	6, 35
NGC 2276	07 10 31	85 50 54	5	17.10	<6.82	11.75	...	580	1130	11800	29500	104	6, 36
NGC 2366	07 23 37	69 19 06	9	3.40	<2.39	10.95	10.60	<250	720	3300	4580	20	5, 6, 18
NGC 2403	07 32 03	65 42 42	5	3.20	19.12	8.43	6.21	3340	6290	51550	148490	53	3, 5, 17
NGC 2441	07 46 20	73 09 23	5	56.50	<3.34	12.57	...	<250	<250	830	3590	<5.7	6, 18
NGC 2525	08 03 15	−11 17 06	5	18.60	<2.86	11.55	...	<250	570	6080	16760	...	6
NGC 2608	08 32 15	28 38 47	4	28.20	1.15	12.53	...	<250	250	2300	5970	27	6, 8, 16
NGC 2642	08 38 14	−03 56 35	3	55.50	<3.47	13.02	...	<250	<260	810	3200	...	6

TABLE 1—*Continued*

Name	R.A. (1950)	Decl. (1950)	T	Dist. (Mpc)	f_X[a] (10^{-13} cgs)	B (mag)	H (mag)	$f_{\nu(12)}$[a] (mJy)[b]	$f_{\nu(25)}$[a] (mJy)[b]	$f_{\nu(60)}$[a] (mJy)[b]	$f_{\nu(100)}$[a] (mJy)[b]	$f_{\nu(6\ cm)}$[a] (mJy)	Refs.
NGC 2683 [c]	08 49 35	33 36 30	3	5.40	<8.24	9.62	6.71	930	520	8330	34020	20	3, 5, 37
NGC 2763	09 04 29	−15 17 53	5	22.20	<2.26	12.35	…	<290	<260	2060	5990	…	6
NGC 2773	09 06 58	07 23 06	5	70.20	2.59	14.27	…	<270	390	2840	5260	…	6
NGC 2775	09 07 41	07 14 30	1	17.10	4.22	10.81	7.83	<250	<280	1740	10470	<10	5, 6, 38
NGC 2777	09 08 02	07 24 42	2	17.10	<1.63	13.88	…	<250	<320	750	1290	<10	6, 38
NGC 2782	09 10 54	40 19 17	1	34.50	<5.40	12.01	9.54	510	1470	8470	13810	55.0	6, 20, 39
NGC 2835	09 15 37	−22 08 48	5	8.50	2.03	10.31	8.92	<250	<250	2560	14400	…	5, 6, 8
NGC 2848	09 17 49	−16 18 47	5	24.10	<2.08	11.95	…	<250	<250	1180	5000	…	6
NGC 2841 [c]	09 18 35	51 11 18	3	24.90	4.71	9.58	6.75	900	830	4410	24210	14	3, 5, 37
NGC 2903	09 29 20	21 43 12	5	6.40	14.34	9.11	6.52	5000	7640	52380	147360	148	3, 5, 17
NGC 2914	09 31 21	10 19 54	2	40.20	<4.03	13.71	…	<84	<108	290	560	<36	16, 40
NGC 2992 [d]	09 43 18	−14 05 41	1	28.40	204.80	12.16	9.09	590	1360	6870	14440	8.5	6, 20, 27
NGC 2993	09 43 23	−14 08 06	2	28.40	<10.02	12.65	10.90	470	1600	10230	15510	…	6, 41, 42
NGC 3031 [c]	09 51 30	69 18 17	3	3.60	92.92	7.39	4.18	5860	5420	44730	174020	118	3, 5, 17
NGC 3034	09 51 41	69 54 54	0	3.60	235.45	8.83	4.68	70[b]	290[b]	1270[b]	1350[b]	4078	3, 5, 16
NGC 3067	09 55 26	32 36 30	3	19.30	<4.94	12.22	…	670	1020	9140	19130	<252	6, 18
NGC 3081	09 57 11	−22 35 05	1	28.00	8.09	12.59	9.81	…	…	…	…	0.9	24, 27, 43
NGC 3066	09 57 51	72 21 54	4	29.60	<8.19	13.27	11.39	<360	540	3030	5680	…	6, 44
NGC 3079 [c]	09 58 35	55 55 24	5	19.40	<11.47	10.41	7.63	1240	2030	42860	88950	330	5, 6, 17
NGC 3077	09 59 22	68 58 30	0	3.60	<3.10	10.41	8.21	520	1890	14800	25110	<24	5, 6, 17
NGC 3125	10 04 18	−29 41 30	0	10.60	<6.76	13.11	11.36	<250	<790	4970	6480	…	6, 14
NGC 3166 [c]	10 11 10	03 40 30	1	8.80	3.04	11.01	…	310	420	5900	13570	<10	12, 20
NGC 3169 [c]	10 11 38	03 43 12	3	8.80	<4.12	10.96	…	550	600	6780	19940	23	6, 38
NGC 3175	10 12 24	−28 37 12	5	11.10	<6.10	11.23	…	690	1210	12400	31440	…	6
NGC 3184	10 15 17	41 40 00	5	7.20	<47.16	10.34	…	<250	<540	2350	15380	13	6, 37, 41
NGC 3227 [d]	10 20 47	20 07 05	3	14.20	140.34	11.18	8.35	670	1740	7980	17460	34	6, 9, 39
I2574	10 24 40	68 40 06	9	3.60	1.44	10.33	9.98	<51	80	2410	10620	…	3, 5
NGC 3281	10 29 36	−34 36 00	1	41.90	<7.22	11.92	9.35	880	2560	6760	7680	26.7	6, 24, 27
NGC 3310	10 35 39	53 45 54	4	14.20	10.92	10.95	9.05	1240	4640	33290	41760	146	6, 16, 44
NGC 3346	10 40 59	15 08 06	5	15.20	<1.99	12.24	…	<250	<360	1340	5520	…	6
NGC 3351	10 41 19	11 58 05	3	10.10	<7.80	10.26	7.29	570	1910	17370	35300	41	5, 6, 36
NGC 3353	10 42 17	56 13 36	3	13.90	1.73	13.00	11.24	<250	920	5180	6650	…	6, 45
NGC 3368 [c]	10 44 08	12 05 05	2	11.30	<5.51	9.80	6.72	370	<560	9160	27440	<24	5, 6, 7
NGC 3389	10 45 50	12 47 54	5	29.90	<6.79	11.83	…	…	…	…	…	…	43
NGC 3395	10 47 02	33 14 41	5	21.20	3.72	12.09	11.66	<250	510	8160	16800	41	16, 30, 46
NGC 3430	10 49 25	33 12 53	4	20.80	<2.87	11.72	9.48	<360	<250	2870	8320	…	5, 6
NGC 3445	10 51 34	57 15 18	5	28.30	<3.33	12.84	…	<250	<260	2200	4460	…	6
NGC 3448	10 51 40	54 34 30	0	19.20	3.81	11.84	…	350	580	5620	11160	39	6, 17
NGC 3455	10 51 52	17 33 05	5	13.30	<2.63	12.51	…	<300	<390	1020	0	…	6
NGC 3489 [c]	10 57 41	14 10 11	0	11.60	<4.60	11.15	…	…	…	…	…	1.5	13, 43
NGC 3504	11 00 29	28 14 30	3	19.80	4.03	11.65	8.63	1040	3720	19170	32890	115	6, 37, 44
NGC 3512	11 01 20	28 18 17	5	17.60	<3.72	12.87	…	<250	<410	1390	4100	…	6
NGC 3593	11 12 00	13 05 24	1	6.60	2.37	11.45	…	1310	2090	18870	35600	67.0	12, 20
NGC 3628 [c]	11 17 40	13 52 05	4	11.90	16.41	9.31	6.73	3080	5300	48510	122170	224	3, 5, 17
NGC 3690	11 25 42	58 50 00	9	43.20	4.80	11.85	9.23	3710	21510	105820	111160	346	16, 30, 41, 47
NGC 3718 [c]	11 29 50	53 20 42	1	14.30	<8.69	11.19	7.62	150	110	760	2520	<90	1, 12, 48
NGC 3729	11 31 04	53 24 00	1	15.50	<3.57	11.91	…	<290	370	2660	7760	…	6
NGC 3783 [d]	11 36 33	−37 27 42	1	35.10	416.29	12.04	9.44	770	2430	3370	5120	13.0	6, 27, 49
NGC 3884 [c]	11 43 36	20 41 04	1	91.50	11.81	13.26	8.93	…	…	…	…	…	50
NGC 3887	11 44 33	−16 34 35	3	12.80	<2.36	11.19	…	<290	<420	4490	15930	…	6
NGC 3888	11 44 55	56 14 53	5	33.40	<1.79	12.55	10.23	320	470	4810	11390	<30	6, 17, 47
NGC 3893	11 46 01	48 59 24	5	15.50	<2.92	10.68	8.65	820	1130	13800	35070	45	5, 6, 17
NGC 3896	11 46 18	48 57 12	0	15.50	<1.99	13.75	…	…	…	…	…	<24	51
NGC 3991	11 54 55	32 36 48	10	42.10	4.82	13.32	12.71	<250	<290	2550	4840	36	6, 16, 46
NGC 3994	11 55 01	32 33 18	5	42.10	<3.39	13.18	…	<270	<520	2750	10430	25	4, 30
NGC 3995	11 55 10	32 34 17	5	42.10	<3.35	12.32	…	…	…	…	…	41	17, 30
I0749	11 56 00	43 00 48	5	15.50	<1.82	12.81	…	…	…	…	…	<27	43, 51
I0750	11 56 17	43 00 06	3	15.50	<1.86	12.39	…	…	…	…	…	63	17, 43
NGC 4036 [c]	11 58 54	62 10 30	0	20.30	<4.10	11.49	8.16	110	<75	580	1450	3.0	12, 20, 48
NGC 4038	11 59 19	−18 35 05	5	23.30	14.16	10.62	…	1220	3910	39220	75970	210	30, 52
NGC 4041	11 59 39	62 25 00	5	18.20	<5.79	11.76	…	820	1400	13870	31490	38	6, 17
NGC 4051 [d]	12 00 37	44 48 42	4	15.50	220.45	10.74	9.21	770	1400	8280	20940	45	6, 17, 39
NGC 4151 [d]	12 08 00	39 40 54	2	13.50	97.00	10.71	7.81	…	…	…	…	158	17, 39, 43

TABLE 1—*Continued*

Name	R.A. (1950)	Decl. (1950)	T	Dist. (Mpc)	f_X[a] (10^{-13} cgs)	B (mag)	H (mag)	$f_{\nu(12)}$[a] (mJy)[b]	$f_{\nu(25)}$[a] (mJy)[b]	$f_{\nu(60)}$[a] (mJy)[b]	$f_{\nu(100)}$[a] (mJy)[b]	$f_{\nu(6\ cm)}$[a] (mJy)	Refs.
NGC 4156	12 08 17	39 44 54	3	90.20	5.37	13.79	...	...	...	...	...	...	43
NGC 4178	12 10 14	11 08 48	5	12.60	<2.79	11.35	9.85	<450	520	4300	9890	...	5, 53
NGC 4190	12 11 13	36 54 35	9	3.50	5.92	13.36	...	<121.1	<123.2	400	1490	5.0	25, 54, 55
NGC 4192 [c]	12 11 15	15 10 48	3	14.50	1.33	10.02	7.53	650	360	7190	23180	33	3, 4, 5
NGC 4206	12 12 44	13 18 12	4	19.70	<2.03	11.73	9.88	<300	<420	1150	2490	...	5, 53
NGC 4212	12 13 07	14 10 48	5	18.70	1.91	11.35	...	770	1170	7500	16940	...	53
NGC 4214	12 13 08	36 36 30	9	4.10	<39.96	10.14	8.53	390	1750	14470	25470	46	5, 6, 36, 41
NGC 4216 [c]	12 13 21	13 25 23	3	16.80	1.14	9.95	7.05	<120	<200	2270	12790	...	3, 5
NGC 4224	12 14 01	07 44 24	1	45.70	<3.90	12.52	...	<200	<180	170	860	...	53
NGC 4236	12 14 22	69 45 00	7	3.60	1.02	9.53	8.66	110	570	3980	10020	...	3, 5, 8, 56
NGC 4235 [d]	12 14 37	07 28 06	1	19.80	40.61	11.89	9.69	<110	<210	320	640	5.3	42, 49, 53
NGC 4244	12 15 00	38 05 11	6	4.50	2.20	9.28	8.43	<51	<70	4200	16060	...	3, 5, 8
NGC 4245	12 15 05	29 52 54	1	11.40	<2.91	12.01	...	<110	<120	810	2680	...	12
NGC 4246	12 15 25	07 27 54	5	36.80	<3.54	12.91	11.25	...	...	...	...	...	5
NGC 4254	12 16 17	14 41 42	5	12.90	4.56	10.10	...	4020	4600	44000	96320	135	17, 53
NGC 4258 [c]	12 16 29	47 35 00	3	7.20	45.66	8.53	5.95	2250	2810	21600	78390	246	3, 5, 17, 41, 56
NGC 4260	12 16 49	06 22 36	1	42.40	<5.86	12.31	...	<500	<230	200	950	...	53
NGC 4298	12 19 00	14 53 05	5	16.10	2.22	11.62	...	610	880	3400	11440	...	53
NGC 4303	12 19 22	04 45 05	5	10.60	9.42	10.12	7.83	3650	5060	41000	77400	120	5, 7, 53
NGC 4321 [c]	12 20 23	16 06 00	5	16.10	8.43	9.98	7.80	2830	3430	31000	70520	82	5, 17, 53
NGC 4351	12 21 29	12 28 54	2	12.90	<3.86	12.79	...	<100	<180	740	2060	...	53
NGC 4378 [c]	12 22 45	05 12 06	1	49.10	3.28	12.22	...	<200	<280	<900	1460	...	8, 53
NGC 4385	12 23 12	00 50 54	4	26.20	<7.43	12.90	10.56	270	1150	4550	5910	...	12, 47
NGC 4388 [c]	12 23 14	12 56 17	2	16.70	6.60	10.79	8.48	1120	3500	11500	18060	97	5, 17, 53
NGC 4394 [c]	12 23 25	18 29 23	3	24.30	<1.43	11.51	8.76	280	270	1150	4990	...	46, 53
NGC 4424	12 24 40	09 41 47	1	4.00	0.44	11.94	...	180	370	3000	5500	...	53
NGC 4429 [c]	12 24 54	11 23 06	0	13.00	3.20	10.97	7.50	200	<120	1600	4580	<8.4	5, 8, 12, 33
NGC 4438 [c]	12 25 14	13 17 06	3	12.30	5.89	10.49	7.78	170	<150	4280	12050	77	3, 7, 57
NGC 4449	12 25 47	44 22 17	9	2.90	12.72	9.94	8.09	...	...	...	...	136	5, 17, 43
NGC 4450 [c]	12 25 59	17 21 42	2	14.20	11.48	10.75	7.96	150	<270	1800	7910	...	5, 53
NGC 4461	12 26 31	13 27 42	1	12.00	<3.44	11.95	...	130	<100	<50	<225	<8.1	12, 33
NGC 4464	12 26 49	08 26 06	0	18.40	<4.48	13.39	10.26	<132	<140	<93	310	...	12, 58
NGC 4477 [c]	12 27 31	13 54 42	0	16.40	7.07	11.30	8.06	160	<132	590	1250	<0.27	5, 12, 13
NGC 4501 [c]	12 29 28	14 41 42	4	17.40	7.53	9.86	7.09	2340	3020	21000	59340	74	5, 17, 53
NGC 4503	12 29 34	11 27 12	1	11.70	<1.29	12.05	...	<75	<84	<120	<507	<7.5	12, 33
NGC 4522	12 31 08	09 27 00	4	16.30	<6.16	11.99	10.35	<210	230	1700	3960	...	5, 53
NGC 4527 [c]	12 31 35	02 55 42	3	13.70	<5.52	10.66	...	1010	1870	25820	63520	151	6, 21
NGC 4535	12 31 48	08 28 36	5	12.40	<2.79	10.32	8.58	1190	1520	14000	31820	38	4, 5, 53
NGC 4536	12 31 54	02 27 42	5	16.60	5.90	10.58	8.11	1410	3470	30330	44980	85	5, 6, 7
I3528 [d]	12 32 25	15 50 30	3	182.20	26.49	15.12	...	<290	<460	1350	5740	...	30
NGC 4548 [c]	12 32 55	14 46 24	3	14.50	<4.85	10.79	...	390	270	2800	10920	...	53
NGC 4565 [c]	12 33 52	26 15 36	3	10.60	7.85	9.10	6.22	1530	1700	9830	47230	45	3, 5, 17
NGC 4567	12 34 01	11 32 00	5	22.30	4.68	11.79	10.55	580	980	15530	47590	46	17, 30, 46
NGC 4569 [c]	12 34 19	13 26 23	2	9.00	6.00	9.79	7.33	750	1280	9190	27330	41	3, 5, 7
NGC 4571	12 34 25	14 29 36	5	14.90	<3.41	11.73	...	<250	<250	950	6530	...	6
NGC 4579 [c]	12 35 12	12 05 35	2	20.00	78.64	10.29	7.28	940	720	6700	18920	57	5, 17, 53
NGC 4594 [c]	12 37 23	−11 21 00	2	9.40	29.24	8.38	5.55	740	500	4260	22860	170	3, 5, 7
NGC 4603	12 38 11	−40 42 05	5	30.30	2.21	11.53	9.26	<250	<250	2220	11410	...	5, 6
NGC 4631	12 39 41	32 48 47	5	3.50	13.81	8.61	6.16	5480	9650	82900	208660	168	3, 5, 37
NGC 4639 [c]	12 40 21	13 31 53	3	25.10	12.95	11.85	...	<300	<270	1850	4470	...	53
NGC 4643 [c]	12 40 48	02 15 06	0	16.00	2.35	11.54	8.09	<80	<144	640	1830	<0.57	5, 8, 12, 13
NGC 4647	12 41 01	11 51 12	5	19.80	<7.58	11.81	10.56	960	900	6100	15570	<9	41, 46, 51, 53
NGC 4651 [c]	12 41 13	16 40 05	5	20.70	<3.43	11.04	8.53	630	720	6300	14190	...	5, 53
NGC 4654	12 41 26	13 24 00	5	13.00	<3.16	10.75	8.69	1260	1730	14700	34400	48	4, 5, 53
NGC 4665	12 42 33	03 19 47	0	16.00	<3.10	11.36	...	<63	<144	<81	<132	<0.33	12, 13
NGC 4689	12 45 15	14 02 05	5	14.10	8.77	11.39	...	480	370	3900	9630	...	53
NGC 4698 [c]	12 45 52	08 45 35	1	36.30	2.38	11.24	8.36	280	<460	630	1890	...	5, 8, 53
NGC 4736 [c]	12 48 32	41 23 36	2	5.90	20.42	8.75	5.15	4770	6830	62410	135340	90	3, 5, 17, 41
NGC 4826 [c]	12 54 17	21 57 05	2	4.60	7.89	8.82	5.99	1710	2000	33860	77380	58	3, 5, 17
NGC 4845	12 55 28	01 50 47	1	30.50	<2.52	11.42	...	440	680	9450	23670	...	6
NGC 4861	12 56 40	35 07 54	9	11.40	7.42	12.17	10.86	<250	390	1840	2390	<30	16, 30, 46
I4182	13 03 30	37 52 30	9	4.70	<20.89	11.73	...	<91.9	<75.47	567	1693	...	25, 41
NGC 5033 [c]	13 11 08	36 51 47	4	12.00	77.37	10.21	7.34	1380	1770	17200	51050	54	3, 5, 17

TABLE 1—*Continued*

Name	R.A. (1950)	Decl. (1950)	T	Dist. (Mpc)	f_X[a] (10^{-13} cgs)	B (mag)	H (mag)	$f_{\nu(12)}$[a] (mJy)[b]	$f_{\nu(25)}$[a] (mJy)[b]	$f_{\nu(60)}$[a] (mJy)[b]	$f_{\nu(100)}$[a] (mJy)[b]	$f_{\nu(6\ cm)}$[a] (mJy)	Refs.
NGC 5037........	13 12 22	−16 19 36	2	20.20	<6.84	12.56	...	<250	<280	710	2890	...	6
NGC 5068........	13 16 13	−20 46 35	5	5.90	<6.37	10.09	...	<300	<950	2340	17120	...	6
NGC 5088........	13 17 42	−12 18 47	5	16.40	<2.21	12.33	...	<250	<460	1770	4100	...	6
NGC 5101........	13 19 01	−27 10 06	1	21.50	<5.90	11.21	...	110	110	780	5600	...	12
NGC 5135........	13 22 56	−29 34 17	3	51.50	3.35	12.37	9.78	670	2480	16180	30830	58.8	6, 24, 27
NGC 5204........	13 27 44	58 40 42	7	7.20	9.58	11.48	10.15	<250	<290	2350	5360	...	5, 6
NGC 5194 [c]......	13 27 46	47 27 17	4	8.40	34.12	8.67	6.52	11020	17470	108680	292080	360	3, 5, 41, 51
NGC 5236........	13 34 10	−29 36 47	5	4.50	50.98	7.98	5.75	26280	47720	266030	638630	490	3, 5, 7
NGC 5248........	13 35 03	09 08 30	4	14.00	3.17	10.63	7.99	960	1490	17720	43970	77	6, 7, 59
NGC 5253........	13 37 05	−31 23 23	0	4.20	2.17	10.47	8.78	2580	12210	30840	27490	65	5, 7, 12
I4329A [d]..........	13 46 28	−30 03 42	0	60.70	494.50	13.67	9.97	1050	2250	2040	1620	...	6, 27, 41
NGC 5313........	13 47 37	40 14 00	3	34.50	<2.12	12.50	...	<340	250	3090	10530	...	6
NGC 5326........	13 48 42	39 49 12	1	34.00	<2.01	12.58	...	...	...	...	...	<20	20, 60
NGC 5350........	13 51 14	40 36 42	4	31.50	<3.30	11.99	...	<640	340	2250	8600	...	6
NGC 5364........	13 53 42	05 15 36	5	15.10	<7.59	10.79	...	<250	<800	2070	11420	...	6
NGC 5410........	13 58 48	41 13 00	5	50.70	<3.62	13.53	12.32	<270	<250	790	1890	...	46
NGC 5457........	14 01 28	54 35 35	5	7.20	19.35	8.21	6.35	6200	11780	88040	252840	150	2, 3, 5, 16
NGC 5474........	14 03 15	53 54 00	6	7.20	<1.74	11.30	11.09	<250	<250	1120	4780	<3	6, 48, 55
NGC 5477........	14 03 47	54 42 06	9	7.20	<2.13	14.20	...	<50.77	<85.13	287	504	<3	25, 55
NGC 5506 [d]......	14 10 38	−02 58 30	1	22.40	111.83	12.26	9.27	1300	4090	8790	8310	132	11, 12, 27
NGC 5548 [d]......	14 15 43	25 22 00	1	68.60	365.19	12.81	10.06	360	760	1040	1730	8	6, 39, 61
NGC 5566 [c]......	14 17 49	04 09 41	1	18.80	2.87	10.78	7.86	<250	<280	1070	5610	...	6, 8, 14
NGC 5585........	14 18 12	56 57 30	7	7.20	<3.16	11.05	9.97	<250	<250	850	3740	5.0	5, 6, 55
NGC 5645........	14 28 10	07 29 47	5	17.20	<4.40	12.45	...	<340	<250	2040	4720	...	6
NGC 5643........	14 29 28	−43 57 12	5	12.70	10.46	10.23	8.41	860	3350	18710	44190	64	6, 27, 62
NGC 5674........	14 31 21	05 39 35	3	98.50	2.52	13.57	...	<250	<360	1500	3500	...	6
NGC 5683 [d]......	14 33 06	48 52 54	0	144.60	49.62	14.98	12.58	<250	<250	470	1340	...	30, 44
NGC 5689........	14 33 44	48 57 35	1	30.30	<3.56	12.03	...	<250	<250	440	1420	<100	6, 20
NGC 5728........	14 39 37	−17 02 17	3	34.90	5.46	11.65	9.19	<320	810	8400	15170	4.6	6, 24, 27
NGC 5850 [c]......	15 04 35	01 44 12	3	33.00	0.91	11.39	...	<250	<250	730	4430	...	6
NGC 5879 [c]......	15 08 29	57 11 23	3	12.40	<3.90	11.38	9.11	280	250	3350	9210	...	5, 6
NGC 5907........	15 14 37	56 30 23	5	11.80	<2.99	9.70	7.35	1220	1350	8780	45760	30	3, 5, 17
NGC 5985 [c]......	15 38 36	59 29 36	3	36.00	<8.49	11.38	...	<250	<250	980	6200	...	6
NGC 6052........	16 03 01	20 40 30	5	63.50	<10.40	13.40	11.70	240	870	7040	10100	48	6, 17, 47
NGC 6300........	17 12 18	−62 45 47	3	12.00	<5.14	10.20	...	740	2150	14050	40250	42	6, 7
NGC 6454 [d]......	17 44 00	55 43 00	5	125.30	10.78	14.06	10.89	<57	<30	<87	<190	588	23
NGC 6503 [c]......	17 49 58	70 09 30	5	5.20	<5.46	10.11	7.65	600	450	7160	25390	21	5, 6, 18
NGC 6744........	19 05 02	−63 56 17	4	8.90	7.17	8.82	6.89	2860	4180	22210	85800	...	3, 5
NGC 6814 [d]......	19 39 55	−10 26 36	4	21.90	27.72	11.32	8.65	330	590	5690	18160	2.2	5, 6, 49
NGC 6822........	19 42 07	−14 55 42	10	0.50	8.56	8.38	...	250	2460	47630	95420	72	7, 41, 63
NGC 6872........	20 11 40	−70 55 30	3	61.80	8.66	11.49	...	<550	<250	1570	7520	38	6, 7
NGC 6890........	20 14 50	−44 57 24	2	32.10	<3.96	12.82	9.93	410	750	3710	8930	4.2	6, 14, 24
NGC 6946........	20 33 48	59 59 00	5	5.50	32.05	7.78	5.86	12130	21180	136690	344370	130	3, 5, 37
NGC 6951 [c]......	20 36 37	65 55 54	3	22.80	<5.81	10.71	8.39	450	1170	13490	37140	36	6, 17, 44
NGC 6962........	20 44 45	00 08 00	2	58.30	<3.03	12.43	...	<250	<250	<400	2020	...	6
I5063.............	20 48 12	−57 15 11	0	43.50	<8.82	12.58	9.62	1220	3990	6530	3920	430.0	12, 20, 27
NGC 7213 [d]......	22 06 12	−47 25 00	1	23.20	932.75	11.13	8.14	520	840	2570	8130	228.0	12, 20, 27
NGC 7314........	22 33 00	−26 18 30	5	19.80	<10.54	11.09	9.06	<270	650	3390	14890	...	5, 6, 41
NGC 7320........	22 33 45	33 41 24	7	15.10	8.64	12.55	11.06	<250	<290	640	3010	...	5, 30
NGC 7331 [c]......	22 34 47	34 09 30	3	15.10	8.81	9.38	6.08	3360	4200	35290	115070	94	3, 5, 17
NGC 7339........	22 35 23	23 31 30	4	17.00	<6.74	12.09	...	...	...	...	...	...	43
NGC 7469 [d]......	23 00 44	08 36 17	2	29.50	390.08	12.64	9.72	1300	5480	26950	35220	78	7, 27, 30
I5283.............	23 00 46	08 37 24	6	29.50	<2.22	14.34	11.59	...	...	...	...	<33	30, 41, 46, 51
NGC 7496........	23 06 59	−43 42 00	5	21.10	<4.45	11.84	9.71	270	1520	8550	15330	...	6, 64
NGC 7552........	23 13 25	−42 51 30	4	21.10	8.74	11.13	8.39	2980	11960	72930	100890	140	6, 7, 14
NGC 7582 [d]......	23 15 38	−42 38 42	2	21.10	11.09	10.83	8.32	1350	6330	48010	72760	110	6, 7, 64
NGC 7590........	23 16 11	−42 30 42	5	21.10	2.83	11.46	9.28	520	840	7390	18020	...	6, 27
NGC 7599........	23 16 36	−42 31 47	5	21.10	2.07	11.22	9.66	520	620	6130	18280	...	6, 32
NGC 7611........	23 17 04	07 47 24	0	47.30	<3.85	13.44	10.12	<105	<170	<140	<735	<1500	1, 12, 65
NGC 7673........	23 25 12	23 18 54	5	48.90	2.78	12.86	...	<250	500	5250	6980	...	6
NGC 7677........	23 25 36	23 15 18	4	50.80	<3.68	13.38	...	280	750	3900	6140	...	6
NGC 7679........	23 26 14	03 14 11	5	71.20	10.72	12.89	9.81	490	1080	7790	10500	<60	1, 12, 44
NGC 7682........	23 26 30	03 15 30	2	71.00	<11.82	13.67	...	...	...	...	...	26	66, 67

TABLE 1—*Continued*

Name	R.A. (1950)	Decl. (1950)	T	Dist. (Mpc)	f_X[a] (10^{-13} cgs)	B (mag)	H (mag)	$f_{\nu(12)}$[a] (mJy)[b]	$f_{\nu(25)}$[a] (mJy)[b]	$f_{\nu(60)}$[a] (mJy)[b]	$f_{\nu(100)}$[a] (mJy)[b]	$f_{\nu(6\ cm)}$[a] (mJy)	Refs.
NGC 7714........	23 33 40	01 52 42	3	39.90	2.82	12.62	10.29	500	2800	11230	11290	22	6, 27, 67
NGC 7769........	23 48 31	19 52 17	4	59.60	<3.09	12.59	9.98	<410	590	4770	11580	<27	6, 44, 51
NGC 7771 [d]......	23 48 52	19 50 00	1	60.60	7.24	12.50	9.77	680	1720	18150	38780	47	30, 46, 68
NGC 7793........	23 55 15	−32 52 05	7	4.00	6.81	9.37	7.82	1540	2090	19620	56340	...	3, 5

NOTE.—Units of right ascension are hours, minutes, and seconds, and units of declination are degrees, arcminutes, and arcseconds. Table 1 is also available in machine-readable form in the electronic edition of the *Astrophysical Journal Supplement*.

[a] The values listed as upper limits are 3 σ.

[b] NGC 224, SMC, NGC 598, LMC, NGC 3034, NGC 253, and NGC 1068 *IRAS* data in Jy. All other *IRAS* data in mJy.

[c] Galaxies exhibiting evidence for some kind of nonstellar ionizing continuum giving rise to nuclear emission, but at a lower level than those flagged with "d" (Ho et al. 1997). These galaxies were included in the statistical analysis.

[d] Galaxies known as AGNs and excluded from the statistical analysis.

REFERENCES.—(1) 6 cm from Ekers & Ekers 1973. (2) X-ray data are from the previous works: LMC and SMC (compilation of Fabbiano 1989), M31 and M32 (Trinchieri & Fabbiano 1991), M33 (Trinchieri, Fabbiano, & Peres 1988), M101 (Trinchieri, Fabbiano, & Romaine 1990). (3) *IRAS* fluxes from Rice et al. 1988. (4) 6 cm from Condon, Frayer, & Broderick 1991 (NED). (5) *H*-band data from Tormen & Burstein 1995. (6) *IRAS* fluxes from the *IRAS* Extragalactic Catalog (Fullmer & Lonsdale 1989). (7) 6 cm from Whiteoak 1970. (8) X-ray source may not be associated with galaxy. (9) 6 cm from Ulvestad, Wilson, & Sramek 1981. (10) *H*-band data from Rieke 1978. (11) 6 cm from Condon et al. 1982. (12) *IRAS* data from Knapp et al. 1989. (13) 6 cm from Fabbiano, Gioia, & Trinchieri 1989. (14) *H*-band data from Griersmith, Hyland, & Jones 1982. (15) N523: no morphological type in RC2 (peculiar galaxy); assigned to late sample. (16) 6 cm from Sulentic 1976. (17) 6 cm from Sramek 1975. (18) 6 cm from Wunderlich & Klein 1991 (NED). (19) *H*-band data from Bothun et al. 1984. (20) 6 cm from Roberts et al. 1991. (21) 6 cm from Becker, White, & Edwards 1991. (22) 6 cm from Jones, Terzian, & Sramek 1981. (23) *H*-band data from Heckman et al. 1983. (24) 6 cm from Ulvestad & Wilson 1989 (NED). (25) *IRAS* fluxes from "1990IRASF.C...0000M" (NED). (26) *H*-band data from Persson, Frogel, & Aaronson 1979. (27) *H*-band data from Glass & Moorwood 1985. (28) 6 cm from Hummel, van der Hulst, & Dickey 1984. (29) *H*-band data from Becklin et al. 1980. (30) *IRAS* fluxes from the *IRAS* Extragalactic Catalog (Fullmer & Lonsdale 1989) blended in the IR: NGC 1512 with NGC 1510, NGC 3395 with NGC 3396, NGC 3690 with IC 694, NGC 3994 with NGC 3995, NGC 4038 with NGC 4039, IC 3528 with NGC 4540, NGC 4567 with NGC 4568, NGC 4861 with IC 3961, NGC 5683 with NGC 5682, NGC 7320 with NGC 7319, NGC 7469 with IC 5283, NGC 7771 with NGC 7770. (31) 6 cm from Disney & Wall 1977. (32) *H*-band data from Glass 1984. (33) 6 cm from Calvani, Fasano, & Franceschini 1989. (34) *H*-band data from Hunter & Gallagher 1985. (35) *H*-band data from Aaronson et al. 1982. (36) 6 cm from Wunderlich, Wielebinski, & Klein 1987. (37) 6 cm from Gioia & Fabbiano 1987. (38) 6 cm from Wright 1974. (39) *H*-band data from Penston et al. 1974. (40) *IRAS* fluxes from Knapp, Bies, & Van Gorkom 1990 (NED). (41) X-ray data from HRI. (42) *H*-band data from Ward et al. 1982. (43) Galaxies not observed by *IRAS* from Lonsdale & Helou 1985. (44) *H*-band data from Balzano & Weedman 1981. (45) *H*-band data from Thuan 1983. (46) *H*-band data from Cutri & McAlary 1985. (47) *H*-band data from Allen 1976. (48) *H*-band data from Willner et al. 1985. (49) 6 cm from Ulvestad & Wilson 1984. (50) *H*-band data from Bothun et al. 1985. (51) 6 cm from Stocke, Tifft, & Kaftan-Kassim 1978. (52) 6 cm from Whiteoak 1970, blended with NGC 4039. (53) *IRAS* fluxes from Helou et al. 1988 (NED). (54) *IRAS* fluxes from Corbelli, Salpeter, & Dickey 1991 (NED). (55) 6 cm from Klein 1986. (56) N4236, N4258: combined X-ray flux of two sources (see FKT92). (57) *H*-band data from Mould, Aaronson, & Huchra 1980. (58) *H*-band data from Frogel et al. 1978. (59) *H*-band data from Glass 1976. (60) FIR detection by Telesco & Harper 1980. (61) 6 cm from Wilson & Ulvestad 1982. (62) 6 cm from Haynes, Huchtmeir, & Siegman 1975. (63) *IRAS* fluxes from Gallagher et al. 1991. (64) *H*-band data from Aaronson et al. 1981. (65) *H*-band data from Mould 1981. (66) FIR from NGC 7682 confused by emission from NGC 7679. (67) 6 cm from Condon 1980. (68) 6 cm from Sramek 1975 blended with NGC 7770.

TABLE 2

PHOTOMETRIC SYSTEMS FOR MAGNITUDE TO FLUX CONVERSION

System	λ_{eff} (μm)	$F_\nu(0)$ (mJy)	References
Cal Tech–Harvard College Observatory......	1.65	980	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Johnson	1.65	1075	13, 14, 15, 16
Anglo-Australian Observatory	1.64	1030	17,[a] 18,[a] 19, 20
Royal Greenwich Observatory................	1.60	1075	21
Kitt Peak National Observatory	1.66	1010	22
	1.64		23[b]

[a] The H magnitudes in references 17 and 18 from the South African Astronomical Observatory were first converted to the AAO system via $H_{AAO} = H_{SAAO}/1.01$.

[b] To convert the H magnitude from reference 23 we used their conversion of $F_\nu = 1.02$ Jy for $H = 15.0$ mag.

REFERENCES.—(1) *H*-band data from Aaronson et al. 1981. (2) *H*-band data from Aaronson et al. 1982. (3) *H*-band data from Becklin et al. 1980. (4) *H*-band data from Bothun et al. 1984. (5) *H*-band data from Bothun et al. 1985. (6) *H*-band data from Frogel et al. 1978. (7) *H*-band data from Hunter & Gallagher 1985. (8) *H*-band data from Mould et al. 1980. (9) *H*-band data from Mould 1981. (10) *H*-band data from Persson et al. 1979. (11) *H*-band data from Penston et al. 1974. (12) *H*-band data from Willner et al. 1985. (13) *H*-band data from Allen 1976. (14) *H*-band data from Cutri & McAlary 1985. (15) *H*-band data from Heckman et al. 1983. (16) *H*-band data from Rieke 1978. (17) *H*-band data from Glass 1984. (18) *H*-band data from Glass & Moorwood 1985. (19) *H*-band data from Griersmith et al. 1982. (20) *H*-band data from Ward et al. 1982. (21) *H*-band data from Glass 1976. (22) *H*-band data from Balzano & Weedman 1981. (23) *H*-band data from Thuan 1983.

TABLE 3

Luminosity Data

Name	log L_X (ergs s^{-1})	log L_B (ergs s^{-1})	log L_H (ergs s^{-1})	log L_{12} (ergs s^{-1})	log L_{25} (ergs s^{-1})	log L_{60} (ergs s^{-1})	log L_{100} (ergs s^{-1})	log L_{FIR} (ergs s^{-1})	log $L_{6\,cm}$ (ergs s^{-1})
NGC 0125........	<41.44	43.35	...	...	...	...	...	...	<37.29
NGC 0224........	39.55	43.33	43.91	42.27	41.63	41.99	42.32	42.59	34.94
NGC 0247........	39.17	42.29	42.36	<40.31	<39.99	41.34	41.47	41.81	...
NGC 0253........	39.90	43.05	43.62	43.01	43.00	43.47	43.33	43.81	36.08
SMC	37.96	41.55	...	39.66	39.82	40.87	40.81	41.24	...
NGC 0309........	<41.31	43.83	...	<43.47	<43.11	43.55	43.65	44.01	...
I1613.............	38.18	40.74	...	<38.82	<38.74	39.40	39.41	39.81	...
NGC 0449........	<41.42	42.79	43.08	<44.20	43.39	43.51	43.20	43.79	36.89
NGC 0520........	<40.72	43.35	43.89	43.33	43.44	44.14	43.92	44.45	36.79
NGC 0521 [b]......	<41.40	43.67	...	<43.87	<43.04	42.90	43.30	43.55	...
NGC 0524 [b]......	41.01	43.52	44.17	42.73	<42.08	42.47	42.42	42.85	35.47
NGC 0523........	<41.12	43.58	43.85	<43.33	42.91	43.45	43.40	43.83	<36.68
NGC 0578........	<40.31	43.13	43.24	42.34	<42.03	42.67	42.87	43.19	...
NGC 0598........	39.25	42.45	42.58	41.64	41.28	41.96	42.03	42.40	34.74
NGC 0625........	<38.91	41.80	...	<41.08	41.16	41.62	41.40	41.93	...
NGC 0628........	39.34	42.73	42.95	42.32	41.83	42.54	42.62	42.98	35.08
I1727 [b]...........	<39.15	42.13	...	<41.44	<40.99	40.84	41.12	41.40	...
NGC 0672........	<39.20	42.50	...	<41.47	41.19	41.81	41.80	42.21	<34.25
NGC 0772 [b]......	<40.89	43.72	44.20	42.78	42.59	43.22	43.45	43.75	36.24
NGC 0871........	<40.91	43.12	...	<43.11	42.76	43.51	43.39	43.86	36.83
NGC 0877........	40.93	43.59	43.97	43.32	43.04	43.92	43.94	44.33	36.85
NGC 0936........	40.29	43.08	43.81	<41.70	<41.53	<41.18	<41.08	<41.54	34.92
NGC 0941........	<40.97	42.56	...	<42.40	<41.95	42.13	42.20	42.57	...
NGC 0945........	<40.85	43.43	...	<43.25	<42.79	43.03	43.23	43.54	...
NGC 0985 [a]......	43.86	43.83	...	<44.19	44.05	44.13	43.86	44.41	...
NGC 1042........	40.41	42.93	...	<42.25	<41.81	42.13	42.46	42.73	...
NGC 1068 [a]......	41.83	43.55	44.35	44.30	44.20	44.19	43.90	44.47	37.55
NGC 1073........	40.15	42.85	...	<42.17	<41.72	42.04	42.35	42.63	36.31
NGC 1087........	<40.60	43.18	...	42.72	42.41	43.12	43.21	43.57	36.10
NGC 1090........	<40.87	43.33	43.60	<42.84	<42.51	42.59	42.82	43.12	...
NGC 1097........	41.00	43.37	44.11	43.18	43.15	43.60	43.58	43.99	36.33
NGC 1218 [a]......	42.62	43.77	44.42	<43.32	43.00	<42.48	42.84	<43.10	<39.39
NGC 1300........	39.93	43.23	43.46	<42.32	<41.94	42.51	42.76	43.06	...
NGC 1313........	39.66	42.50	...	41.57	41.68	42.35	42.35	42.75	34.86
NGC 1317........	<40.03	42.71	...	42.26	41.79	42.59	42.59	42.99	...
NGC 1350........	<40.29	43.09	43.64	<42.21	<41.76	<41.78	42.21	<42.44	...
NGC 1358 [b]......	40.69	43.29	43.93	<42.67	<42.39	42.53	42.51	42.92	35.32
NGC 1365........	40.84	43.46	44.12	43.46	43.48	43.95	43.88	44.31	36.63
NGC 1380........	40.31	42.93	43.74	41.91	41.07	41.92	41.96	42.34	34.45
NGC 1386........	40.38	42.59	43.39	42.54	42.54	42.77	42.56	43.08	35.78
NGC 1398........	40.15	43.26	44.00	<42.19	<41.74	41.97	42.48	42.70	...
NGC 1421........	40.77	43.39	43.47	42.74	42.32	43.25	43.31	43.68	...
I0342.............	39.88	43.60	44.47	42.77	42.60	43.01	43.01	43.41	34.79
NGC 1512........	<39.67	42.54	43.20	<41.90	<41.24	41.46	41.15	41.73	<34.90
NGC 1533........	39.90	42.59	...	<41.63	40.99	41.39	41.55	41.88	<35.58
NGC 1559........	40.48	42.99	43.21	42.64	42.46	43.28	43.25	43.67	36.27
NGC 1566 [a]......	41.38	43.22	43.75	42.39	42.16	42.98	43.09	43.44	36.04
NGC 1569........	38.83	41.60	42.23	40.57	41.13	41.62	41.25	41.88	34.68
NGC 1614........	41.50	43.20	43.81	44.03	44.31	44.62	44.19	44.86	...
NGC 1625........	<41.11	43.67	...	<43.27	<42.82	43.11	43.25	43.59	...
NGC 1672........	40.33	43.17	43.66	42.82	42.80	43.40	43.29	43.75	36.15
NGC 1784........	<40.45	43.21	43.66	<42.64	<42.33	42.84	43.00	43.33	...
LMC.............	38.41	42.07	...	41.12	41.12	41.81	41.74	42.18	...
NGC 1961 [b]......	41.28	44.26	44.75	43.74	43.26	44.07	44.18	44.53	37.34
U3691............	<40.54	43.25	42.73	<42.60	<42.15	42.55	42.58	42.96	...
NGC 2276........	<40.38	42.67	...	42.51	42.35	43.03	43.01	43.42	36.26
NGC 2366........	<38.52	41.59	41.15	<40.74	40.75	41.07	40.80	41.36	34.14
NGC 2403........	39.37	42.54	42.86	41.82	41.64	42.21	42.26	42.64	34.51
NGC 2441........	<41.11	43.38	...	<43.18	<42.73	42.91	43.14	43.44	<36.04
NGC 2525........	<40.07	42.82	...	<42.22	42.12	42.81	42.84	43.23	...
NGC 2608........	40.04	42.79	...	<42.58	42.13	42.75	42.76	43.16	36.11
NGC 2642........	<41.11	43.19	...	<43.17	<42.73	42.89	43.07	43.39	...
NGC 2683 [b]......	<39.46	42.52	43.11	41.71	41.01	41.88	42.08	42.39	34.54
NGC 2763........	<40.13	42.66	...	<42.44	<41.94	42.50	42.55	42.93	...

TABLE 3—*Continued*

Name	log L_X (ergs s^{-1})	log L_B (ergs s^{-1})	log L_H (ergs s^{-1})	log L_{12} (ergs s^{-1})	log L_{25} (ergs s^{-1})	log L_{60} (ergs s^{-1})	log L_{100} (ergs s^{-1})	log L_{FIR} (ergs s^{-1})	log $L_{6 cm}$ (ergs s^{-1})
NGC 2773	41.19	42.89	...	<43.41	43.11	43.64	43.49	43.97	...
NGC 2775	40.17	43.05	43.66	<42.15	<41.74	42.20	42.57	42.82	<35.24
NGC 2777	<39.76	41.82	...	<42.15	<41.80	41.83	41.66	42.15	<35.24
NGC 2782	<40.89	43.18	43.58	43.06	43.07	43.49	43.29	43.81	36.59
NGC 2835	39.25	42.64	42.62	<41.54	<41.09	41.76	42.10	42.36	...
NGC 2848	<40.16	42.89	...	<42.44	<41.99	42.33	42.54	42.85	...
NGC 2841 [b]	40.54	43.87	44.42	43.03	42.54	42.93	43.26	43.52	35.72
NGC 2903	39.85	42.87	43.33	42.59	42.32	42.82	42.86	43.24	35.56
NGC 2914	<40.89	42.63	...	<42.41	<42.07	42.16	42.04	42.50	<36.54
NGC 2992 [a]	42.30	42.95	43.64	42.96	42.87	43.23	43.15	43.59	35.61
NGC 2993	<40.99	42.75	42.87	42.86	42.94	43.41	43.18	43.71	...
NGC 3031 [b]	40.16	43.06	43.77	42.16	41.68	42.25	42.43	42.75	34.96
NGC 3034	40.56	42.49	43.57	43.22	43.40	43.71	43.32	43.96	36.50
NGC 3067	<40.34	42.59	...	42.68	42.41	43.02	42.93	43.38	<36.75
NGC 3081	40.88	42.76	43.29	...	...	...	...	...	34.63
NGC 3066	<40.93	42.54	42.70	<42.78	42.50	42.91	42.78	43.25	...
NGC 3079 [b]	<40.71	43.32	43.85	42.95	42.71	43.70	43.60	44.06	36.87
NGC 3077	<38.68	41.85	42.16	41.11	41.22	41.77	41.59	42.09	<34.27
NGC 3125	<39.96	41.71	41.84	<41.73	<41.78	42.24	41.94	42.52	...
NGC 3166 [b]	39.45	42.39	...	41.66	41.34	42.15	42.10	42.53	<34.67
NGC 3169 [b]	<39.58	42.41	...	41.91	41.50	42.21	42.27	42.64	35.03
NGC 3175	<39.96	42.50	...	42.21	42.00	42.67	42.67	43.07	...
NGC 3184	<40.47	42.48	...	<41.39	<41.28	41.58	41.98	42.23	34.61
NGC 3227 [a]	41.53	42.74	43.31	42.41	42.37	42.70	42.63	43.06	35.61
I2574	38.35	41.89	41.45	<40.10	39.85	40.99	41.22	41.52	...
NGC 3281	<41.18	43.38	43.87	43.47	43.48	43.57	43.21	43.82	36.45
NGC 3310	40.42	42.83	42.99	42.68	42.80	43.32	43.00	43.59	36.25
NGC 3346	<39.74	42.37	...	<42.04	<41.75	41.98	42.18	42.50	...
NGC 3351	<39.98	42.81	43.42	42.05	42.12	42.74	42.64	43.09	35.40
NGC 3353	39.60	41.99	42.13	<41.97	42.08	42.49	42.19	42.77	...
NGC 3368 [b]	<39.93	43.09	43.75	41.96	<41.68	42.56	42.62	42.99	<35.26
NGC 3389	<40.86	43.12	...	...	...	...	...	...	...
NGC 3395	40.30	42.72	42.45	<42.33	42.19	43.06	42.96	43.41	36.04
NGC 3430	<40.17	42.85	43.17	<42.47	<41.86	42.58	42.64	43.01	...
NGC 3445	<40.51	42.67	...	<42.58	<42.15	42.74	42.63	43.09	...
NGC 3448	40.23	42.74	...	42.39	42.16	42.81	42.69	43.16	35.94
NGC 3455	<39.75	42.15	...	<42.01	<41.67	41.75	...	41.85	...
NGC 3489 [b]	<39.87	42.57	...	...	...	...	...	...	34.08
NGC 3504	40.28	42.84	43.50	42.89	42.99	43.37	43.19	43.69	36.43
NGC 3512	<40.14	42.25	...	<42.17	<41.93	42.12	42.18	42.56	...
NGC 3593	39.09	41.96	...	42.04	41.79	42.41	42.27	42.74	35.24
NGC 3628 [b]	40.45	43.33	43.79	42.92	42.70	43.33	43.32	43.72	36.28
NGC 3690	41.03	43.44	43.90	44.12	44.43	44.79	44.40	45.03	37.59
NGC 3718 [b]	<40.33	42.74	43.62	41.77	41.18	41.68	41.79	42.14	<36.04
NGC 3729	<40.01	42.52	...	<42.12	41.78	42.30	42.35	42.73	...
NGC 3783 [a]	42.79	43.18	43.66	43.26	43.31	43.11	42.88	43.41	35.98
NGC 3884 [b]	42.07	43.52	44.08	...	...	...	...	...	...
NGC 3887	<39.67	42.64	...	<41.96	<41.67	42.36	42.50	42.83	...
NGC 3888	<40.38	42.93	43.35	42.83	42.55	43.22	43.18	43.60	<36.30
NGC 3893	<39.93	43.01	43.25	42.58	42.26	43.01	43.00	43.41	35.81
NGC 3896	<39.76	41.79	...	...	...	...	...	...	<35.54
NGC 3991	41.01	42.83	42.70	<42.93	<42.54	43.15	43.01	43.49	36.58
NGC 3994	<40.86	42.88	...	<42.96	<42.79	43.18	43.35	43.67	36.42
NGC 3995	<40.85	43.23	...	...	...	...	...	...	36.64
I0749	<39.72	42.16	...	...	...	...	...	...	<35.59
I0750	<39.73	42.33	...	...	...	...	...	...	35.96
NGC 4036 [b]	<40.31	42.92	43.73	41.94	<41.32	41.87	41.86	42.26	34.87
NGC 4038	40.96	43.39	...	43.10	43.16	43.82	43.69	44.16	36.84
NGC 4041	<40.36	42.72	...	42.72	42.50	43.15	43.10	43.53	35.88
NGC 4051 [a]	41.80	42.99	43.06	42.55	42.36	42.79	42.78	43.19	35.81
NGC 4151 [a]	41.33	42.88	43.51	...	...	...	...	...	36.24
NGC 4156	41.72	43.30	...	...	...	...	...	...	...
NGC 4178	<39.73	42.57	42.59	<42.14	41.75	42.32	42.28	42.70	...
NGC 4190	38.94	40.65	...	<40.45	<40.01	40.18	40.34	40.67	33.57
NGC 4192 [b]	39.53	43.22	43.64	42.42	41.71	42.67	42.77	43.12	35.62

TABLE 3—*Continued*

Name	log L_X (ergs s^{-1})	log L_B (ergs s^{-1})	log L_H (ergs s^{-1})	log L_{12} (ergs s^{-1})	log L_{25} (ergs s^{-1})	log L_{60} (ergs s^{-1})	log L_{100} (ergs s^{-1})	log L_{FIR} (ergs s^{-1})	log $L_{6 cm}$ (ergs s^{-1})
NGC 4206........	<39.98	42.80	42.97	<42.35	<42.04	42.14	42.06	42.51	...
NGC 4212........	39.90	42.91	...	42.71	42.44	42.91	42.85	43.28	...
NGC 4214........	<39.91	42.07	42.14	41.10	41.30	41.88	41.71	42.20	34.67
NGC 4216 [b]......	39.59	43.38	43.96	<41.81	<41.58	42.30	42.64	42.90	...
NGC 4224........	<40.99	43.22	...	<42.90	<42.40	42.04	42.33	42.61	...
NGC 4236........	38.20	42.21	41.98	40.44	40.70	41.20	41.19	41.60	...
NGC 4235 [a]......	41.28	42.74	43.18	<41.92	<41.74	41.59	41.48	41.94	35.10
NGC 4244........	38.73	42.50	42.26	<40.30	<39.98	41.42	41.59	41.92	...
NGC 4245........	<39.66	42.21	...	<41.44	<41.02	41.51	41.62	41.97	...
NGC 4246........	<40.76	42.87	42.96	...	...	...	...	...	...
NGC 4254........	39.96	43.09	...	43.11	42.71	43.36	43.28	43.72	36.13
NGC 4258 [b]......	40.45	43.21	43.66	42.35	41.99	42.54	42.69	43.02	35.88
NGC 4260........	<41.10	43.24	...	<43.23	<42.45	42.05	42.31	42.60	...
NGC 4298........	39.84	42.67	...	42.48	42.19	42.44	42.55	42.90	...
NGC 4303........	40.10	42.91	43.25	42.89	42.58	43.15	43.02	43.49	35.91
NGC 4321 [b]......	40.42	43.33	43.62	43.15	42.78	43.40	43.34	43.77	36.11
NGC 4351........	<39.89	42.01	...	<41.50	<41.31	41.58	41.61	42.00	...
NGC 4378 [b]......	40.98	43.40	...	<42.96	<42.66	<42.83	42.63	<43.14	...
NGC 4385........	<40.79	42.58	43.01	42.55	42.73	42.99	42.69	43.26	...
NGC 4388 [b]......	40.34	43.03	43.38	42.78	42.82	43.00	42.78	43.30	36.21
NGC 4394 [b]......	<40.01	43.07	43.62	42.50	42.03	42.32	42.55	42.85	...
NGC 4424........	37.93	41.33	...	40.74	40.60	41.17	41.02	41.51	...
NGC 4429 [b]......	39.81	42.74	43.56	41.81	<41.14	41.92	41.97	42.35	<34.93
NGC 4438 [b]......	40.03	42.89	43.43	41.69	<41.19	42.30	42.34	42.72	35.84
NGC 4449........	39.11	41.85	42.02	...	...	...	...	...	34.84
NGC 4450 [b]......	40.44	42.91	43.45	41.76	<41.57	42.05	42.28	42.58	...
NGC 4461........	<39.77	42.28	...	41.55	<40.99	<40.35	<40.59	<40.89	<34.84
NGC 4464........	<40.26	42.08	42.75	<41.93	<41.51	<40.99	41.10	<41.45	...
NGC 4477 [b]......	40.36	42.81	43.54	41.92	<41.38	41.69	41.61	42.05	<33.64
NGC 4501 [b]......	40.44	43.44	43.98	43.13	42.79	43.29	43.33	43.72	36.13
NGC 4503........	<39.33	42.22	...	<41.29	<40.89	<40.71	<40.92	<41.23	<34.79
NGC 4522........	<40.29	42.53	42.61	<42.03	41.62	42.15	42.10	42.53	...
NGC 4527 [b]......	<40.09	42.91	...	42.56	42.37	43.18	43.16	43.57	36.23
NGC 4535........	<39.71	42.96	43.08	42.54	42.20	42.82	42.77	43.20	35.54
NGC 4536........	40.29	43.11	43.53	42.87	42.81	43.41	43.17	43.71	36.15
I3528 [a]...........	43.02	43.38	...	<44.26	<44.01	44.14	44.36	44.67	...
NGC 4548 [b]......	<40.09	42.91	...	42.20	41.58	42.26	42.44	42.76	...
NGC 4565 [b]......	40.02	43.32	43.89	42.52	42.11	42.53	42.80	43.09	35.48
NGC 4567........	40.45	42.89	42.90	42.74	42.52	43.38	43.45	43.82	36.14
NGC 4569 [b]......	39.77	42.90	43.31	42.06	41.85	42.36	42.42	42.80	35.30
NGC 4571........	<39.96	42.56	...	<42.03	<41.57	41.81	42.24	42.48	...
NGC 4579 [b]......	41.58	43.39	44.02	42.86	42.29	42.92	42.96	43.34	36.14
NGC 4594 [b]......	40.49	43.50	44.06	42.10	41.47	42.07	42.38	42.66	35.95
NGC 4603........	40.39	43.26	43.59	<42.64	<42.19	42.80	43.10	43.38	...
NGC 4631........	39.31	42.55	42.95	42.11	41.90	42.50	42.49	42.89	35.09
NGC 4639 [b]......	40.99	42.96	...	<42.56	<42.06	42.56	42.53	42.94	...
NGC 4643 [b]......	39.86	42.70	43.50	<41.59	<41.40	41.71	41.75	42.13	<33.94
NGC 4647........	<40.55	42.77	42.76	42.86	42.38	42.87	42.86	43.27	<35.33
NGC 4651 [b]......	<40.25	43.12	43.55	42.71	42.32	42.92	42.86	43.29	...
NGC 4654........	<39.81	42.83	43.08	42.61	42.30	42.89	42.84	43.27	35.69
NGC 4665........	<39.98	42.77	...	<41.49	<41.40	<40.81	<40.61	<41.12	<33.70
NGC 4689........	40.32	42.65	...	42.26	41.70	42.38	42.36	42.77	...
NGC 4698 [b]......	40.58	43.53	44.11	42.85	<42.61	42.41	42.48	42.85	...
NGC 4736 [b]......	39.93	42.95	43.81	42.50	42.21	42.83	42.75	43.19	35.27
NGC 4826 [b]......	39.30	42.70	43.26	41.84	41.46	42.35	42.29	42.72	34.87
NGC 4845........	<40.45	43.31	...	42.89	42.63	43.43	43.42	43.83	...
NGC 4861........	40.06	42.15	42.26	<41.79	41.53	41.87	41.57	42.15	<35.37
I4182.............	<39.74	41.56	...	<40.59	<40.05	40.59	40.65	41.02	...
NGC 5033 [b]......	41.13	42.98	43.55	42.58	42.24	42.88	42.95	43.32	35.67
NGC 5037........	<40.52	42.49	...	<42.29	<41.89	41.95	42.15	42.46	...
NGC 5068........	<39.42	42.41	...	<41.30	<41.35	41.40	41.85	42.09	...
NGC 5088........	<39.85	42.40	...	<42.11	<41.92	42.17	42.12	42.55	...
NGC 5101........	<40.51	43.09	...	41.99	41.54	42.05	42.49	42.73	...
NGC 5135........	41.03	43.38	43.94	43.53	43.65	44.12	43.99	44.46	36.97
NGC 5204........	39.78	42.03	41.98	<41.39	<41.01	41.58	41.52	41.95	...

TABLE 3—*Continued*

Name	log L_X (ergs s^{-1})	log L_B (ergs s^{-1})	log L_H (ergs s^{-1})	log L_{12} (ergs s^{-1})	log L_{25} (ergs s^{-1})	log L_{60} (ergs s^{-1})	log L_{100} (ergs s^{-1})	log L_{FIR} (ergs s^{-1})	log $L_{6 cm}$ (ergs s^{-1})
NGC 5194 [b]......	40.46	43.29	43.57	43.17	42.92	43.38	43.39	43.79	36.18
NGC 5236........	40.09	43.02	43.34	43.01	42.81	43.22	43.19	43.61	35.77
NGC 5248........	39.87	42.95	43.47	42.56	42.29	43.03	43.01	43.42	35.96
NGC 5253........	38.66	41.96	42.06	41.94	42.16	42.23	41.76	42.46	34.84
I4329A [a]	43.34	43.00	43.96	43.87	43.75	43.37	42.86	43.58	...
NGC 5313........	<40.48	42.98	...	<42.89	42.30	43.06	43.18	43.52	...
NGC 5326........	<40.45	42.94	...	...	...	...	...	...	<36.14
NGC 5350........	<40.59	43.11	...	<43.08	42.36	42.84	43.01	43.33	...
NGC 5364........	<40.32	42.95	...	<42.04	<42.09	42.16	42.49	42.76	...
NGC 5410........	<41.05	42.90	42.87	<43.12	<42.64	42.80	42.77	43.18	...
NGC 5457........	40.08	43.34	43.50	42.79	42.62	43.15	43.20	43.58	35.67
NGC 5474........	<39.03	42.10	41.64	<41.39	<40.94	41.25	41.47	41.78	<33.97
NGC 5477........	<39.12	40.94	...	<40.70	<40.47	40.66	40.50	40.99	<33.97
NGC 5506 [a]......	41.83	42.70	43.37	43.10	43.14	43.14	42.70	43.37	36.60
NGC 5548 [a]......	43.31	43.45	43.92	43.51	43.38	43.18	42.99	43.50	36.35
NGC 5566 [b]......	40.09	43.14	43.85	<42.23	<41.82	42.07	42.38	42.65	...
NGC 5585........	<39.29	42.20	42.06	<41.39	<40.94	41.13	41.37	41.67	34.19
NGC 5645........	<40.19	42.40	...	<42.28	<41.70	42.27	42.22	42.65	...
NGC 5643........	40.31	43.02	43.23	42.42	42.56	42.97	42.93	43.35	35.79
NGC 5674........	41.47	43.46	...	<43.67	<43.37	43.65	43.61	44.03	...
NGC 5683 [a]......	43.10	43.23	43.85	<44.00	<43.55	43.48	43.53	43.91	...
NGC 5689........	<40.59	43.06	...	<42.64	<42.19	42.10	42.19	42.55	<36.74
NGC 5728........	40.90	43.33	43.83	<42.87	42.82	43.50	43.35	43.83	35.53
NGC 5850 [b]......	40.08	43.39	...	<42.72	<42.26	42.39	42.76	43.02	...
NGC 5879 [b]......	<39.86	42.54	42.87	41.92	41.41	42.20	42.23	42.62	...
NGC 5907........	<39.70	43.17	43.53	42.51	42.10	42.58	42.88	43.16	35.40
NGC 5985 [b]......	<41.12	43.47	...	<42.79	<42.34	42.59	42.98	43.23	...
NGC 6052........	<41.70	43.15	43.33	43.27	43.37	43.94	43.69	44.24	37.06
NGC 6300........	<39.95	42.98	...	42.31	42.32	42.80	42.84	43.22	35.56
NGC 6454 [a]......	42.31	43.48	44.22	<43.23	<42.50	<42.63	<42.55	<42.99	38.74
NGC 6503 [b]......	<39.25	42.29	42.70	41.49	40.91	41.78	41.92	42.25	34.53
NGC 6744........	39.83	43.28	43.47	42.64	42.35	42.74	42.91	43.23	...
NGC 6814 [a]......	41.20	43.06	43.55	42.48	42.28	42.93	43.02	43.38	34.80
NGC 6822........	37.41	40.95	...	39.08	39.62	40.57	40.46	40.92	33.03
NGC 6872........	41.60	43.89	...	<43.60	<42.81	43.27	43.54	43.82	36.94
NGC 6890........	<40.69	42.79	43.42	42.91	42.72	43.07	43.04	43.46	35.41
NGC 6946........	40.07	43.27	43.47	42.85	42.64	43.11	43.10	43.50	35.37
NGC 6951 [b]......	<40.56	43.34	43.84	42.65	42.61	43.34	43.36	43.75	36.05
NGC 6962........	<41.09	43.46	...	<43.21	<42.76	<42.62	42.92	<43.20	...
I5063	<41.30	43.15	43.81	43.64	43.71	43.58	42.95	43.77	37.69
NGC 7213 [a]......	42.78	43.18	43.91	42.73	42.48	42.63	42.72	43.08	36.87
NGC 7314........	<40.70	43.06	43.30	<42.31	42.24	42.61	42.85	43.15	...
NGC 7320........	40.37	42.24	42.26	<42.04	<41.65	41.65	41.92	42.21	...
NGC 7331 [b]......	40.38	43.51	44.26	43.17	42.81	43.40	43.50	43.85	36.11
NGC 7339........	<40.37	42.53	...	...	...	...	...	...	...
NGC 7469 [a]......	42.61	42.79	43.35	43.33	43.51	43.86	43.57	44.14	36.61
I5283	<40.37	42.11	42.74	...	...	...	...	...	<36.24
NGC 7496........	<40.38	42.82	43.09	42.36	42.66	43.07	42.91	43.40	...
NGC 7552........	40.67	43.10	43.67	43.40	43.56	44.00	43.73	44.29	36.57
NGC 7582 [a]......	40.77	43.22	43.73	43.06	43.28	43.82	43.59	44.12	36.47
NGC 7590........	40.18	42.97	43.32	42.65	42.40	43.01	42.98	43.40	...
NGC 7599........	40.04	43.07	43.23	42.65	42.27	42.93	42.99	43.36	...
NGC 7611........	<41.01	42.88	43.68	<42.65	<42.41	<41.99	<42.30	<42.57	<38.30
NGC 7673........	40.90	43.14	...	<43.06	42.91	43.59	43.30	43.87	...
NGC 7677........	<41.06	42.96	...	43.14	43.12	43.49	43.28	43.80	...
NGC 7679........	41.81	43.45	44.02	43.68	43.57	44.09	43.81	44.37	<37.26
NGC 7682........	<41.85	43.14	...	...	...	...	...	...	36.90
NGC 7714........	40.73	43.06	43.39	43.18	43.48	43.74	43.33	43.99	36.32
NGC 7769........	<41.12	43.42	43.87	<43.44	43.15	43.72	43.69	44.11	<36.76
NGC 7771 [a]......	41.50	43.47	44.09	43.68	43.63	44.31	44.23	44.68	37.02
NGC 7793........	39.12	42.36	42.41	41.67	41.35	41.99	42.03	42.41	...

NOTE.—Table 3 is also available in machine-readable form in the electronic edition of the *Astrophysical Journal Supplement*.

[a] Galaxies known as AGNs and excluded from the statistical analysis.

[b] Galaxies exhibiting evidence for some kind of nonstellar ionizing continuum giving rise to nuclear emission, but at a lower level than those flagged with " a " (Ho et al. 1997). These galaxies were included in the staticticał analysis.

central problem of homogenizing the data sets consists of correcting the H-band magnitudes to the same aperture/diameter ratio, such that $\log(A/D) = -0.5$. In order to perform this correction, Tormen & Burstein (1995) determine empirical curves of growth for four different morphological subgroups and use the morphologically appropriate curve of growth to correct the aperture photometry of each galaxy to the fiducial value of $H_{-0.5}$ [which is the value of H evaluated at $\log(A/D) = -0.5$]. We found corrected H-band magnitudes for 87 *Einstein* galaxies in Tormen & Burstein (1995) and adopted these magnitudes as the normalized near-infrared magnitudes.

Additionally, there were 72 *Einstein* galaxies for which we found H-band data in the Catalogue of Near-Infrared and Visual Photometry, but which are not included in the Tormen & Burstein (1995) sample. To correct the H-band magnitude for these 72 galaxies in a manner consistent with that of Tormen & Burstein (1995), we found the isophotal diameter of each galaxy in the RC3 (corrected for galactic extinction in the same way that Tormen & Burstein 1995 correct the diameter); we then computed its $\log(A/D)$ value based on the RC3 isophotal diameter and the aperture listed in the literature for the H-band measurement; finally, we applied one of the four Tormen & Burstein (1995) growth curves, based on our determination of the galaxy's morphological type, to correct the listed aperture measurement to the fiducial aperture magnitude for $\log(A/D) = -0.5$, i.e., $H_{-0.5}$.

In order to check the validity of our method for correcting the magnitudes of these 72 galaxies, we also applied the method to the 87 galaxies included in Tormen & Burstein (1995), for which we also have uncorrected aperture photometry from the literature. We wanted to ascertain that our application of the Tormen & Burstein (1995) growth curves gave us corrected values consistent with the values Tormen & Burstein (1995) determined. Indeed, we found very good agreement between the corrected $H_{-0.5}$ magnitudes we calculated and the values listed in Tormen & Burstein (1995) (Fig. 3).

We also addressed the issue of Galactic extinction. Tormen & Burstein (1995) correct all growth curve–corrected magnitudes for Galactic extinction, using the correction $A_H = 0.1A_g$, which usually results in a correction of less than 0.05 mag. Therefore, the 87 galaxies in our sample that were also in the sample considered by Tormen & Burstein (1995) have H-band magnitudes that are corrected for Galactic extinction. We then considered the 72 galaxies in our H-band sample that were not included in Tormen & Burstein (1995). Since H-band magnitudes for these galaxies were assembled from a variety of sources in the literature, it was necessary to check whether or not each literature source included a correction for Galactic extinction. We found that for all but two galaxies, the H-band magnitude in the literature was either corrected for Galactic extinction or uncorrected but with a required correction of less than 0.05 mag. Therefore, we only added our own corrections to the two galaxies that did not meet the above stated criteria, IC 342, which required an H-band correction of 0.30 mag, and NGC 6951, whose required correction was 0.09 mag. We did not apply the negative internal extinction correction, discussed by Willick et al. (1996), as it is clear that this correction is neither significant nor perhaps even valid in most cases (see Willick et al. 1996, where they say that they cannot rule out $C^H_{\rm int} = 0$ for Aaronson's

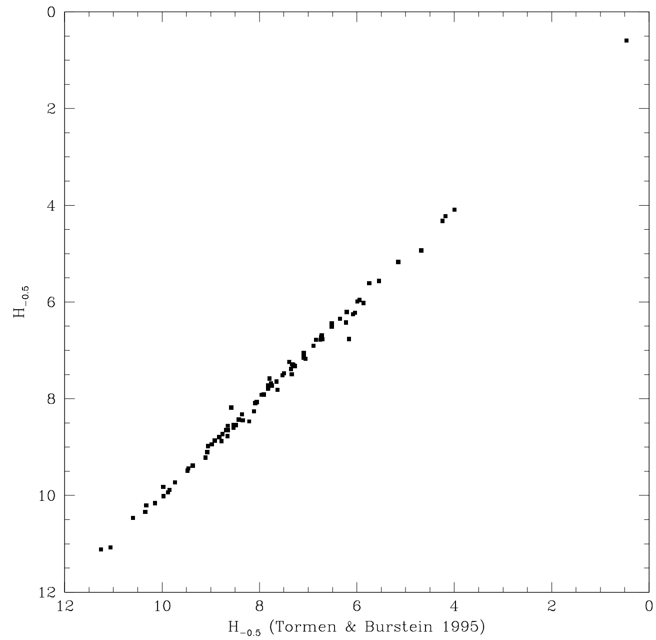


FIG. 3.—Comparison of our calculated $H_{-0.5}$ with those of Tormen & Burstein (1995).

H-band data). The correction is $H_{\rm corrected} = H - C^H_{\rm int}$ log (axial ratio) so that if $C^H_{\rm int} = 0$, the internal extinction correction is 0.

Once we corrected all of the H magnitudes to $\log(A/D) = -0.5$ and had taken into account Galactic extinction, we then converted each corrected magnitude to an H flux (νF_ν) (units are ergs s^{-1} cm^{-2}), according to the specific photometric system used in the reference from which we obtain the measurement. This conversion requires $\lambda_{\rm eff}$, the effective central wavelength of the H filter used, as well as $F_\nu(0)$, the F_ν corresponding to $H = 0.0$ mag. Therefore, the conversion to H flux consists of the following:

$$F = \frac{c}{\lambda_{\rm eff}} F_\nu(0) \times 10^{-H/2.5} , \quad (1)$$

where F is the H flux and $c = 3 \times 10^{10}$ cm s^{-1} is the speed of light.

Table 2 lists the many conversion systems we used and the references to which they apply.

IRAS flux densities [$f_{\nu(12)}$, $f_{\nu(25)}$, $f_{\nu(60)}$, $f_{\nu(100)}$].—The *IRAS* flux densities or 3 σ upper limits were assembled from several sources. For nearby extended galaxies, we adopted the values reported in Rice et al. (1988). We obtained 12, 25, and 60 μm fluxes for 238 galaxies (218 normal, 20 AGNs) and 100 μm fluxes for 237 galaxies (217 normal, 20 AGNs). To derive fluxes from the flux densities, the *IRAS* data were multiplied by the appropriate bandwidths and normalizations, indicated in the *IRAS* Explanatory Supplement (Beichman & Neugebauer 1984). To calculate the far-infrared flux $F_{\rm FIR}$, we followed Lonsdale Persson & Helou (1987).

6 cm *radio continuum* ($f_{6\ {\rm cm}}$).—Our literature search yielded 153 flux densities and upper limits (136 for normal galaxies and 17 for AGNs). We multiplied the radio measurements by a 1% bandwidth (50 MHz), to convert flux densities to fluxes. Previous work on spiral galaxies established the connection between the nonthermal radio continuum emission of spiral galaxies and star formation

(Fabbiano et al. 1988; Dickey & Salpeter 1984; Helou et al. 1985; de Jong et al. 1985), making use of 20 cm flux densities, which are likely to be less contaminated by thermal emission (see Gioia, Gregorini, & Klein 1982) and therefore are more representative of the nonthermal continuum. The present use of 6 cm flux densities was motivated by our desire to compare the properties of early-type bulge-dominated spirals with those of E and S0 galaxies (Eskridge et al. 1995c). Although the 6 cm flux cannot be used to prove cleanly the connection between cosmic-ray production and star formation, this connection has already been proved (see references above). Any general consideration about connections of the overall radio emission and other galactic properties will still be valid.

4. DISTRIBUTIONS OF L_X AND L_X/L_B

Figures 4 and 5 show the distributions of X-ray luminosities L_X and X-ray–to–optical ratios L_X/L_B (bright AGNs excluded) for the total sample, the three subsamples, and E and S0 galaxies (from FKT92; Eskridge et al. 1995c) for comparison. We see the already noticed effect (e.g., Fabbiano 1990) that the distributions of L_X and L_X/L_B of E and S0 galaxies extend to higher values than do those of spirals. We do not see any major differences in comparing the three

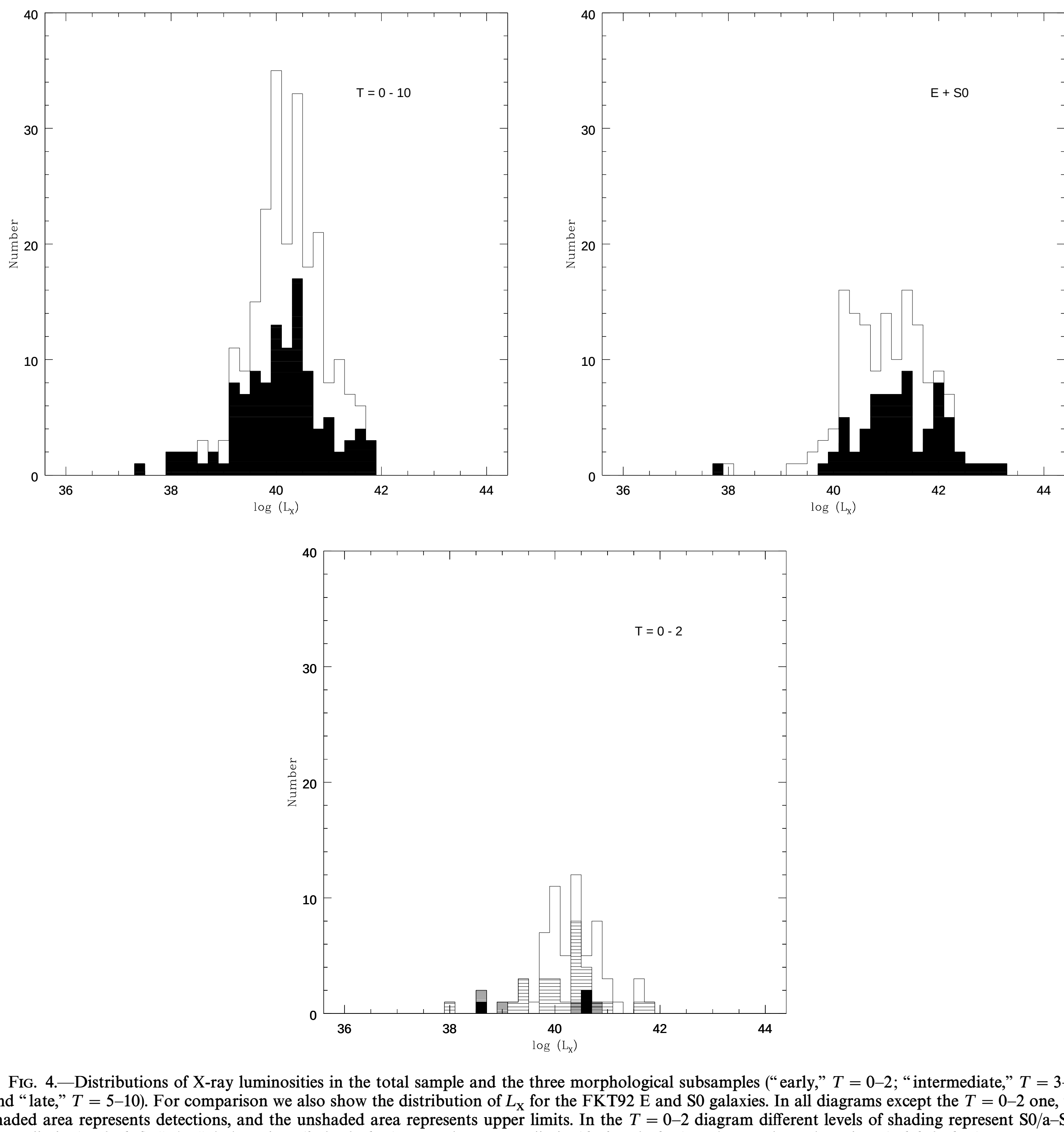


FIG. 4.—Distributions of X-ray luminosities in the total sample and the three morphological subsamples ("early," $T = 0$–2; "intermediate," $T = 3$–4; and "late," $T = 5$–10). For comparison we also show the distribution of L_X for the FKT92 E and S0 galaxies. In all diagrams except the $T = 0$–2 one, the shaded area represents detections, and the unshaded area represents upper limits. In the $T = 0$–2 diagram different levels of shading represent S0/a–Sab upper limits (*unshaded*), S0/a–Sab detections (*light shading*), amorphous upper limits (*darker shading*), and amorphous detections (*solid shading*).

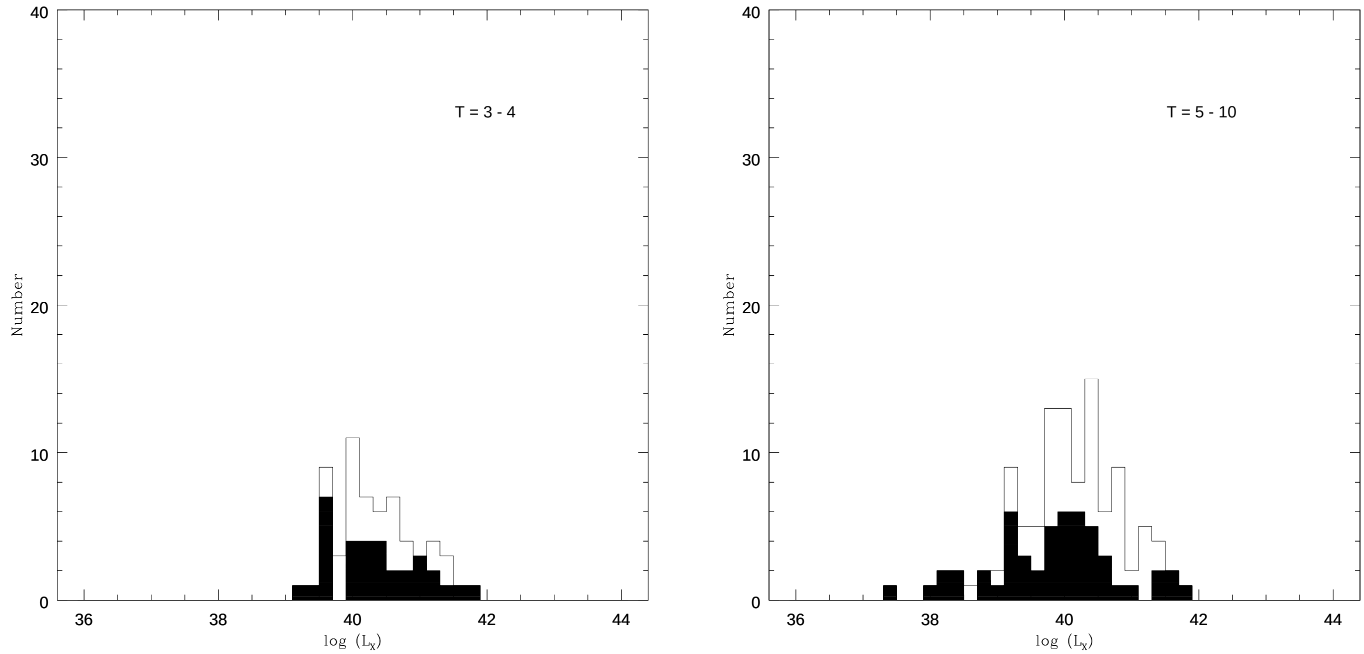


FIG. 4.—*Continued*

spiral subsamples, with the exception that the luminosity distribution of $T = 3–4$ galaxies does not include any detections in the lower luminosity bins, which are populated in the other subsamples. However, the distribution of $T = 3–4$ limits is consistent with the presence of less X-ray luminous galaxies.

5. CORRELATIONS

Figure 6 displays the scatter diagrams from the 15 pairs of luminosity variables under consideration. Several features of these plots are apparent without any formal statistical analysis. First, in the plots that feature L_X as the dependent variable, the flagged AGNs lie clearly above the distribution of normal spiral galaxies in the vertical direction, indicating the excess nuclear X-ray emission from these objects. Second, most of the pairwise relationships display more scatter in the early-type ($T = 0–2$, S0/a–Sab) subsample. The seven amorphous galaxies in the early subsample are indicated by different symbols in the scatter diagrams. They were not included in the analysis of this sample. Third, for the majority of the luminosity-luminosity pairs, the distribution of points in the middle ($T = 3–4$) morphological range is basically coincident with the upper right-hand portion of the distribution of late-type ($T = 5–10$) points. Figure 7 displays scatter plots for luminosity-ratio pairs. Also here we find that trends are visible in total and late/intermediate samples but tend to disappear in the early sample.

We performed bivariate correlation tests and regression analysis as well as multivariate analysis on these data. All information (both detections and limits) was used in the analysis, by applying survival analysis techniques. Bivariate analysis was conducted with ASURV Rev 1.1 (LaValley, Isobe, & Feigelson 1992 and references therein), a software package that implements methods of univariate and bivariate survival analysis (both correlation tests and regression methods). We tested for the significance of each correlation, and we derived regression parameters for each of them. Multivariate analysis addresses the following question: is a given correlation intrinsically significant (and thus indicative of an astrophysical effect), or is it the secondary effect of other more fundamental links? To test for the presence of intrinsic correlation among two variables, which would be present even if all other variables did not vary, we used the Spearman partial rank method (Kendall & Stuart 1976; for previous applications see Fabbiano et al. 1988; Eskridge et al. 1995c). The partial rank analysis takes full advantage of the multiwavelength nature of our set of data and correlations, providing information that a simple bivariate correlation analysis cannot supply. We used the generalized Spearman's rho method from ASURV to generate correlation coefficients to use in the partial rank analysis.

These methods and the results of the analysis are described in §§ 6 and 7. Below we discuss biases that may affect correlation studies and show that our results are free from serious effects.

Distance biases (chiefly the Malmquist bias) are a well-known danger in any correlation analysis and may result in spurious luminosity correlations when working with flux-limited samples. Our results directly confirm that a Malmquist bias is not significant. First, most regression bisector slopes (see Fig. 6 and § 6) indicate nonlinear relationships between variables. If the correlations were due to a Malmquist bias, they would only appear as linear relationships in the log-log plane (power law $\alpha = 1$). Second, even for linear correlations, a correlation is evident in flux-flux plots (not shown).

Moreover, the characteristics of our sample selection and the inclusion of limits in the analysis protect us from these effects. The *Einstein* sample of spiral galaxies contains an optical selection criterion but is not defined by any a priori X-ray flux or volume limit, and by including upper limits in our analysis in the X-rays and in the other wave bands, we have avoided the problem of an a posteriori flux bias toward higher luminosity objects in the various luminosity parameters. Censored analysis tools make full use of both detections and limits. Under these circumstances, working

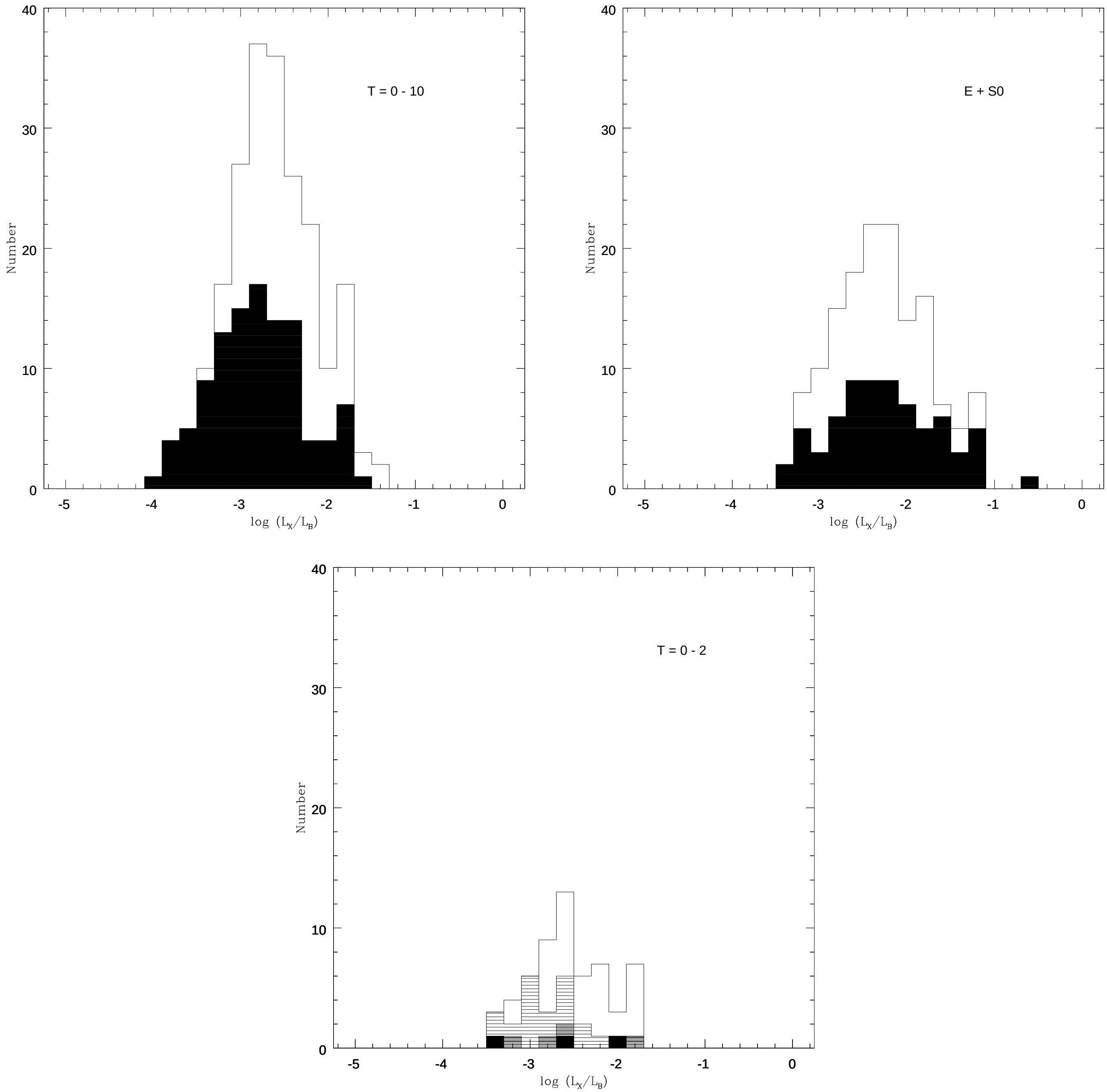


FIG. 5.—Distributions of L_X/L_B in the total sample and the three morphological subsamples ("early," $T = 0$–2; "intermediate," $T = 3$–4; and "late," $T = 5$–10). For comparison we also show the distribution of L_X/L_B for the FKT92 E and S0 galaxies. Same shading conventions as in Fig. 4.

with fluxes may provide erroneous results, which are absent when luminosities are used (as rigorously demonstrated by Feigelson & Berg 1983; see Fabbiano & Trinchieri 1985; Fabbiano et al. 1988). Furthermore, we have used the partial Spearman rank test, to test directly if a given correlation could have arisen solely from a distance effect, by including the distance among the variables tested (§ 7 and Appendix C). All the bivariate correlations are still very significant when the correlation is tested under the hypothesis that the distance be held fixed, and the results of the multivariate analysis are only minimally affected.

Figure 8 supports our conclusion that the sample is not affected by a distance-limited issue: we have a fair sampling of both detections and limits at any given distance.

Correlations cannot be created by a distance bias in our sample; however, the presence of upper limits could in some cases imply that we are not in the presence of a very tight functional relation, but of a "wedge" effect. Although this possibility cannot be completely discounted, it would not change the results of the presence of correlations; it may only weaken any model based on intrinsic underlying power laws.

Another distance-related problem consists of the uncertainty in the adopted distance for any individual galaxy. Our results are robust to uncertainties in the assumed distances. We obtain very consistent results when we use directly the set of distances in FKT92 or the present set of Table 1. The FKT92 distances are mostly from Tully 1988,

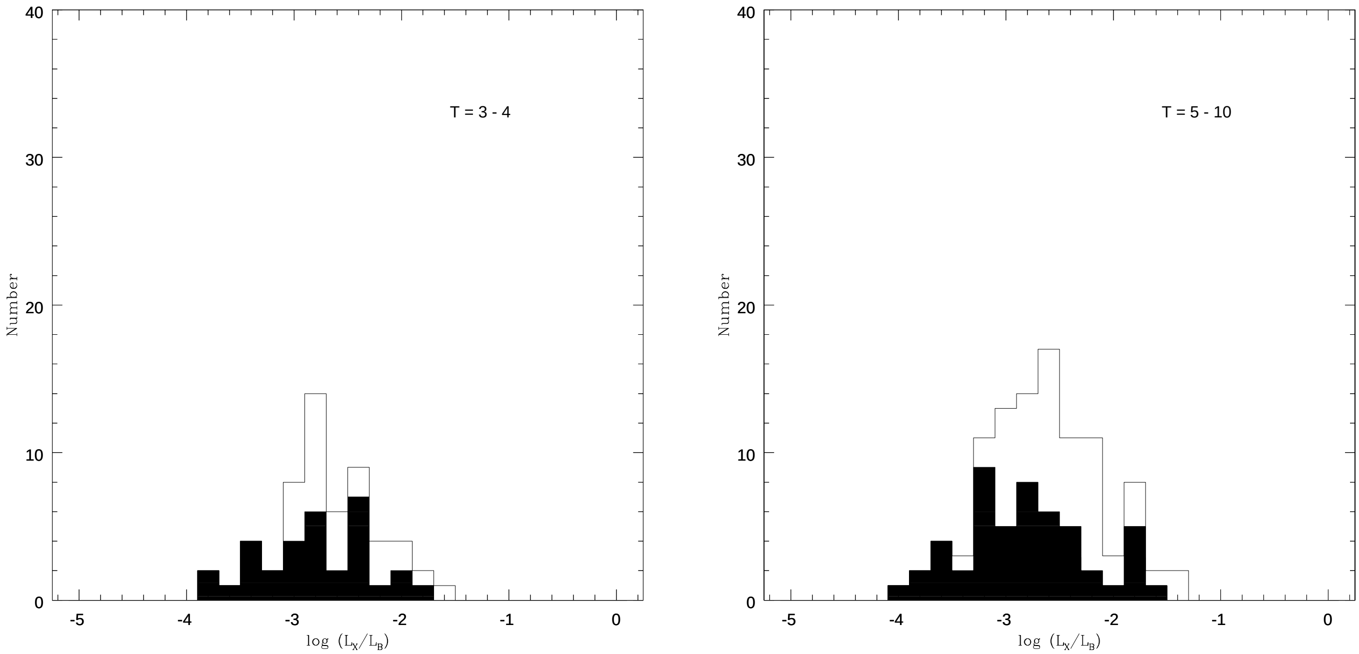


FIG. 5.—*Continued*

corrected for $H_0 = 50$. Some of these distances give values for nearby galaxies (e.g., M82), which differ significantly from recent Cepheid-based estimates. However, these differences do not affect the results of the correlation analysis. Moreover, we tested the robustness of our results by randomly perturbing each adopted galaxy distance by a factor of 2 either high or low. This is the outer envelop in the dispersion from a comparison of distances from galactic indicators and distances from the Hubble flow that we have assembled here (Appendix A). Even in this extreme case, the basic correlation slopes stand. Uncertainties arising from different Hubble flow corrections are much smaller (see Appendix A, where we compare Yahil, Tammann, & Sandage 1977 [YTS77] and cosmic microwave background [CMB] corrections). Comparing runs of our bivariate probability and regression analyses for the entire set of correlations using the two sets of distances shows that in all cases the resulting effects on the correlations are insignificant (well within the errors). The reason is that the cosmic scatter of galactic properties at a given luminosity is much greater than the scatter introduced by current distance uncertainties.

Another possible bias consists of beam size effects, which could turn a linear power-law relation between two variables into a nonlinear relation, if one of the variables is observed with a small beam. This effect occurs if the galaxies farther away are systematically more luminous, of course of smaller angular size, and therefore not so undersampled by a small beam size as a nearby galaxy would be. A beam size effect could also obscure the strength of an observed correlation, by introducing extra scatter into a distribution of points, because the small beam samples a different fraction of the total galaxy luminosity based on the angular size of the galaxy.

Beam size effects should not be a problem with the X-ray flux data, since the *Einstein* field is much larger than any of the galaxies observed, and a method akin to surface photometry was followed to derive the fluxes, while limits were derived from areas comparable to the optical extent of the galaxies (see FKT92). Beam size effects are also not a problem for optical (*B*) and near-IR (*H*) data, since in both cases the magnitudes refer to the same fraction of the total galaxy. We addressed the finite nature of the *IRAS* beam size by using Rice et al. (1988) fluxes, computed specially for large optical galaxies. To investigate possible beam size dependencies in the 6 cm data, we have plotted galaxies of different optical sizes with different symbols in an L_X-$L_{6\ \rm cm}$ scatter plot (Fig. 9). We do not find any significant differences that may be linked to the galaxy size and conclude that the 6 cm data do not suffer significantly of beam size bias.

Because of the finite resolution of the observations, especially in the infrared and X-ray bands, in a very few cases of close-by or interacting galaxies the fluxes may include the contribution of more than one object. Table 1 shows that, of the galaxies used for the analysis, no "early" sample galaxy is thus affected, and only one (out of 62) "intermediate" sample galaxy and seven (out of 107) "late" sample galaxies suffer of source confusion in the IR; given the uneven data coverage, only three of the latter galaxies were included in the multivariate analysis. Inspection of FKT92 shows that confusion in the X-rays is also likely. Given the small percentage of the sample suffering of this problem, we do not think that our results would be significantly affected. This effect may result in some scatter in the correlations, which are, however, especially tight in the "late" sample. The only foreseeable effect would be to worsen somewhat correlations involving the IR or the X-ray band and one of the other variables. However, the resulting scatter would be well within the observed dispersion of the correlations.

Finally, we checked that uncertainties in the $H_{-0.5}$ magnitude corrections (§ 3) did not affect our results, by rerunning the analysis for a set of $H_{-0.5}$ values we calculated using the Tormen & Burstein (1995) prescription (see Fig. 3) and by comparing the results with those obtained from the values in Table 1. The results are virtually identical.

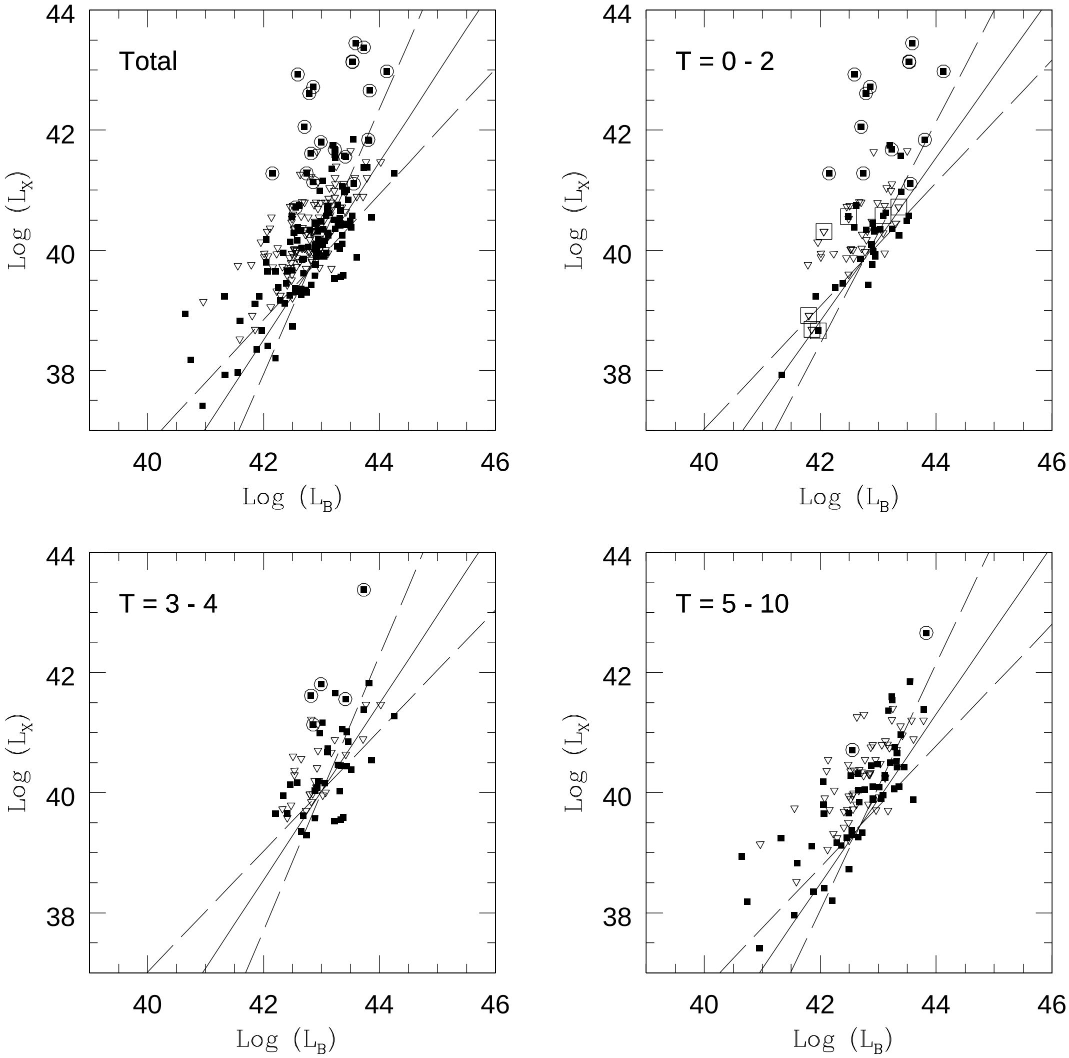
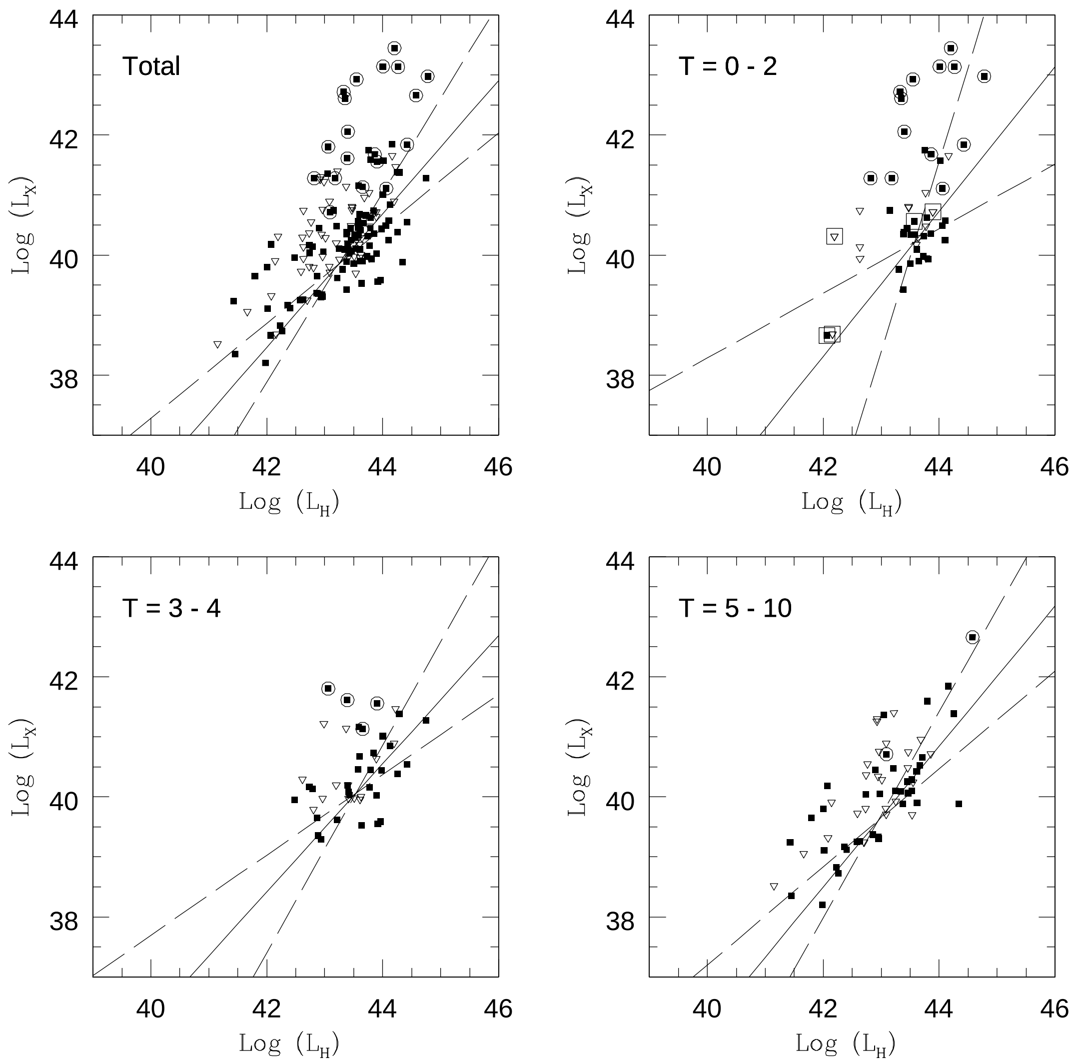


FIG. 6.—Scatter diagrams for luminosity pairs. For each pair, the scatter diagrams for the total sample and for the three morphological subsamples ("early," $T = 0$–2; "intermediate," $T = 3$–4; and "late," $T = 5$–10) are plotted. Filled squares identify detections on both axes; triangles identify upper limits in one of the axes, with the apex pointing in the direction of the limit; open circles identify upper limits in both axes; circles surrounding another symbol identify the flagged AGNs, which were not included in the statistical analysis; squares surrounding another symbol identify amorphous galaxies, which were not included in the $T = 0$–2 analysis. The solid lines across the points represent the regression bisectors, while individual regressions are represented by the two dashed lines.



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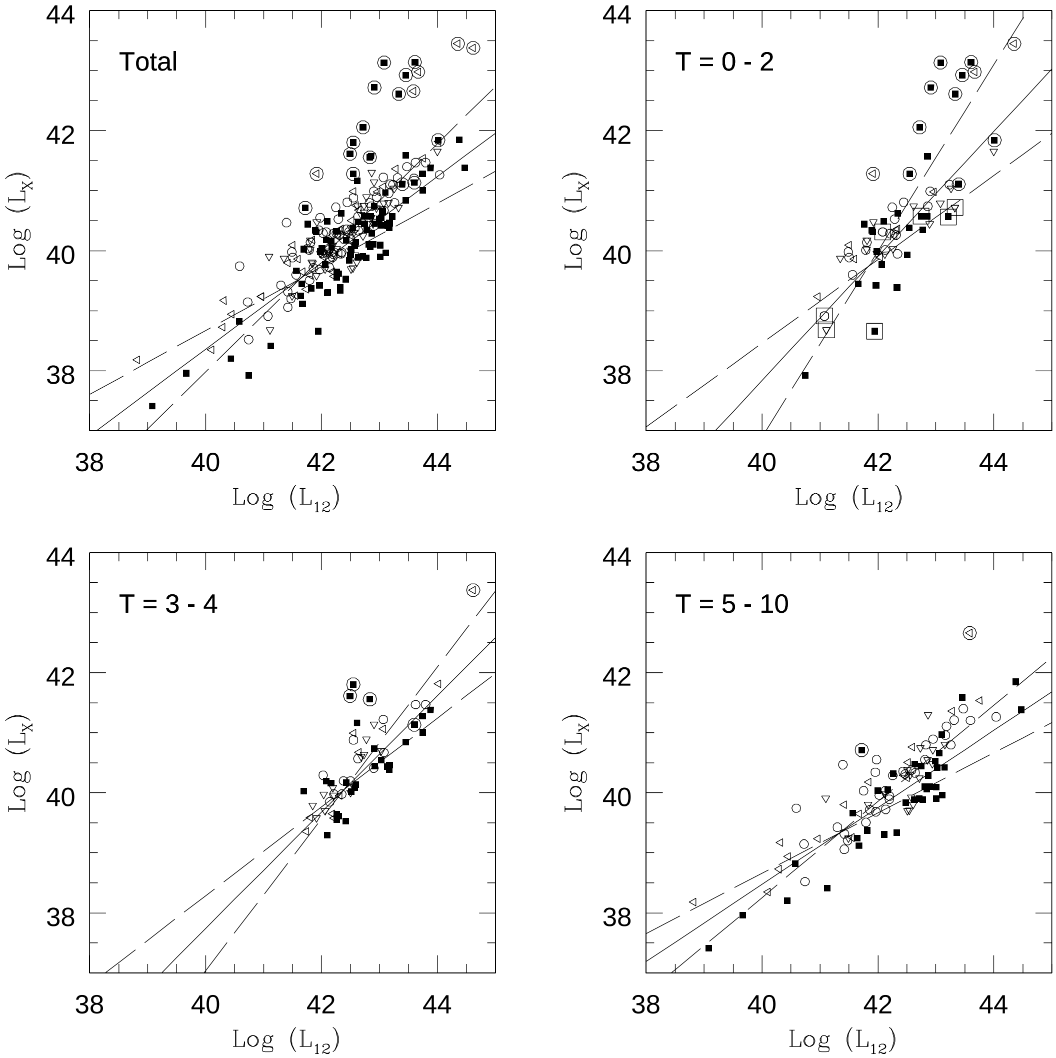

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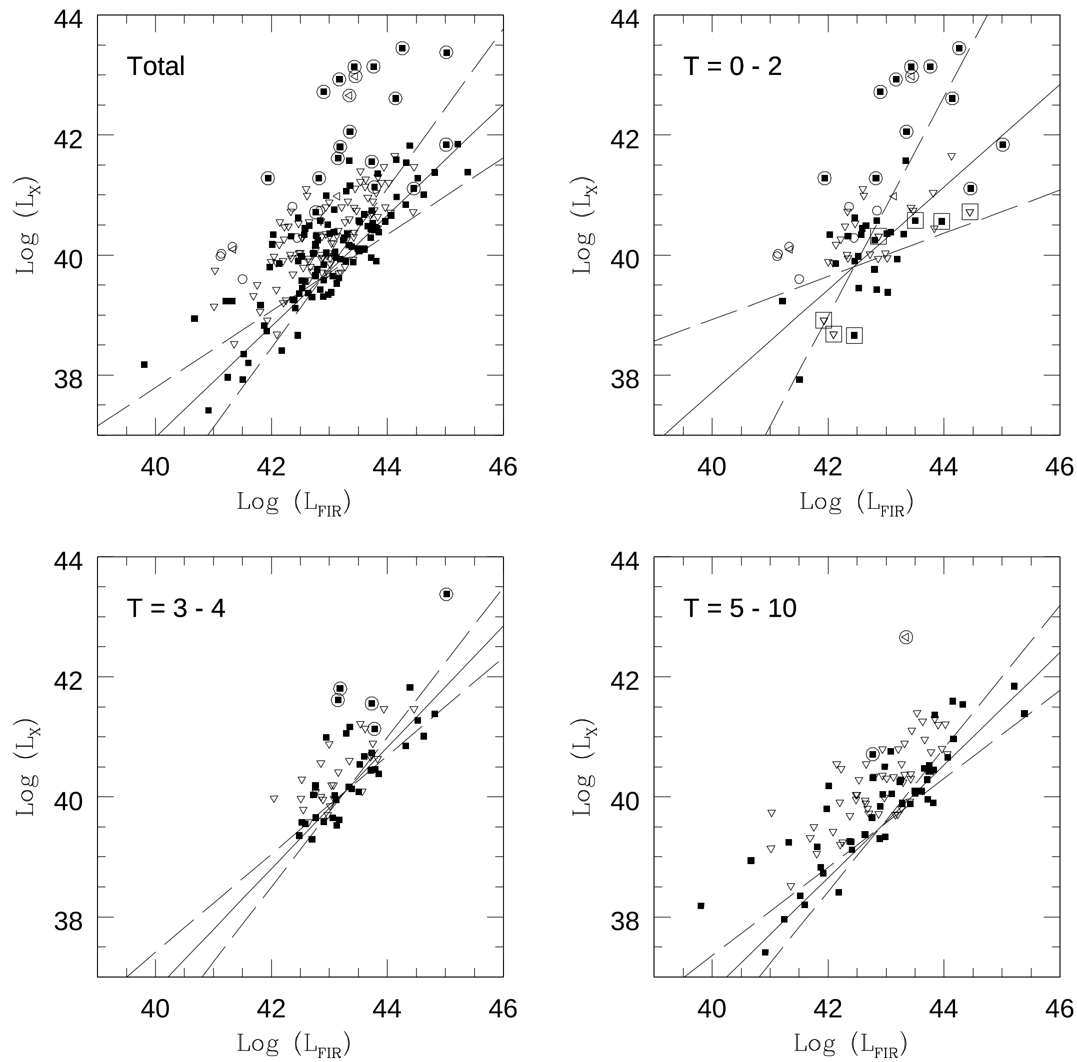

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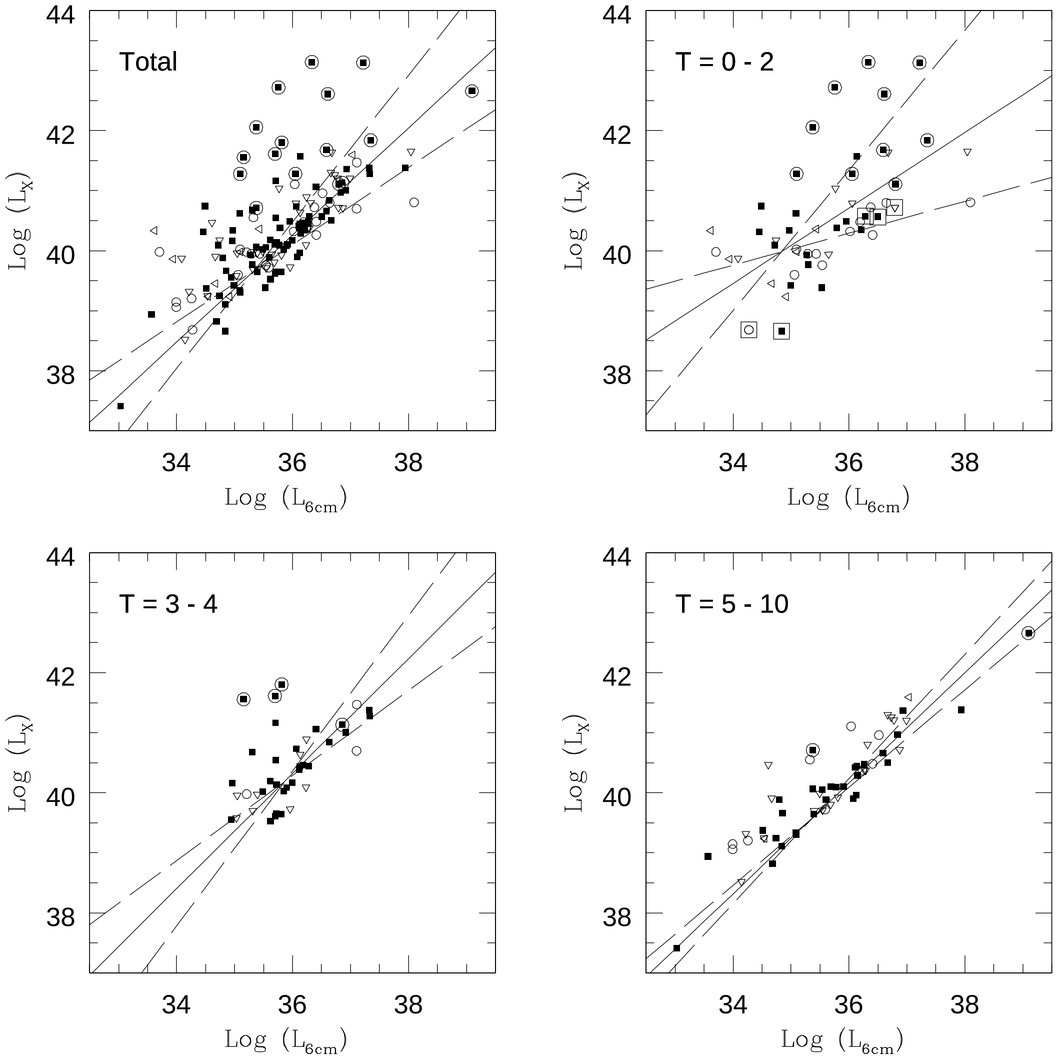

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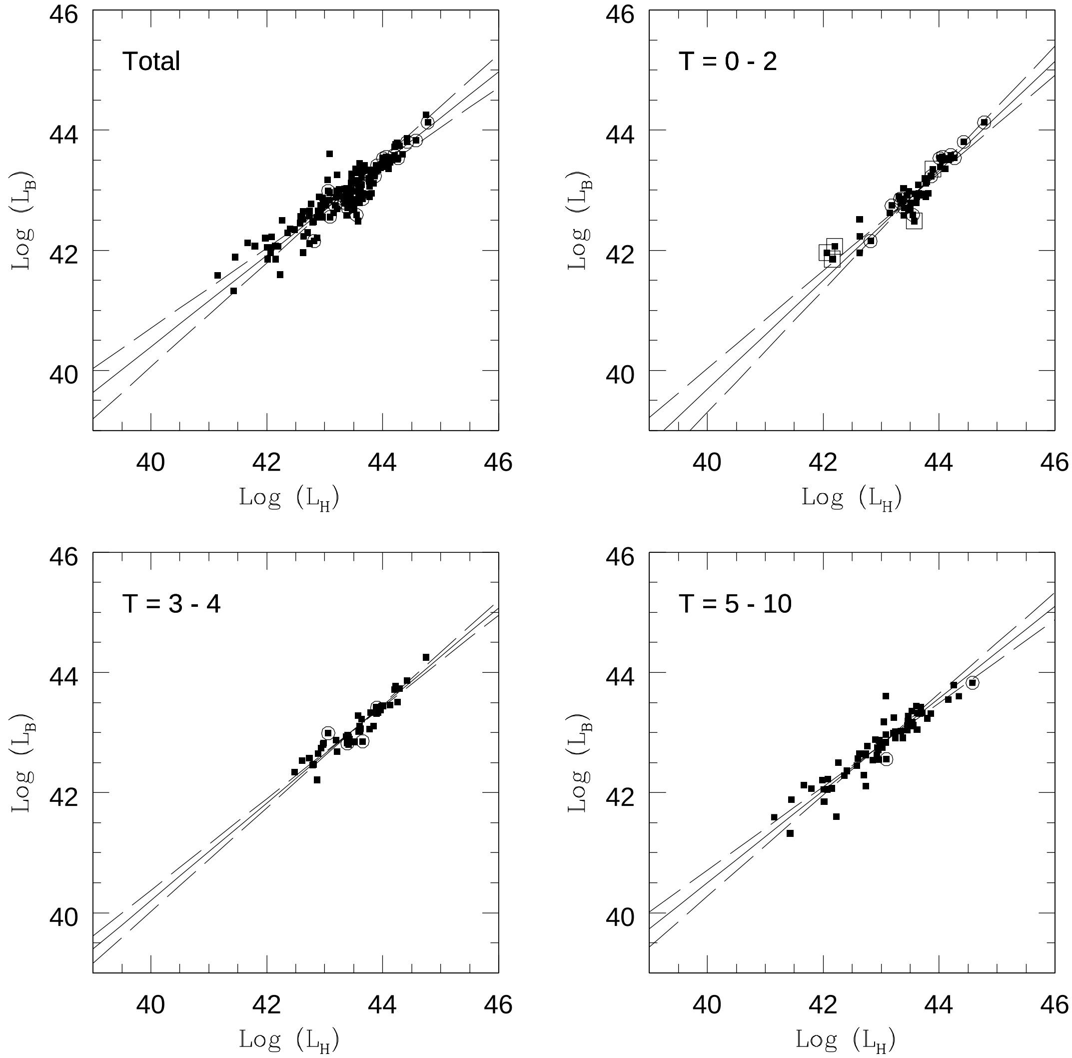

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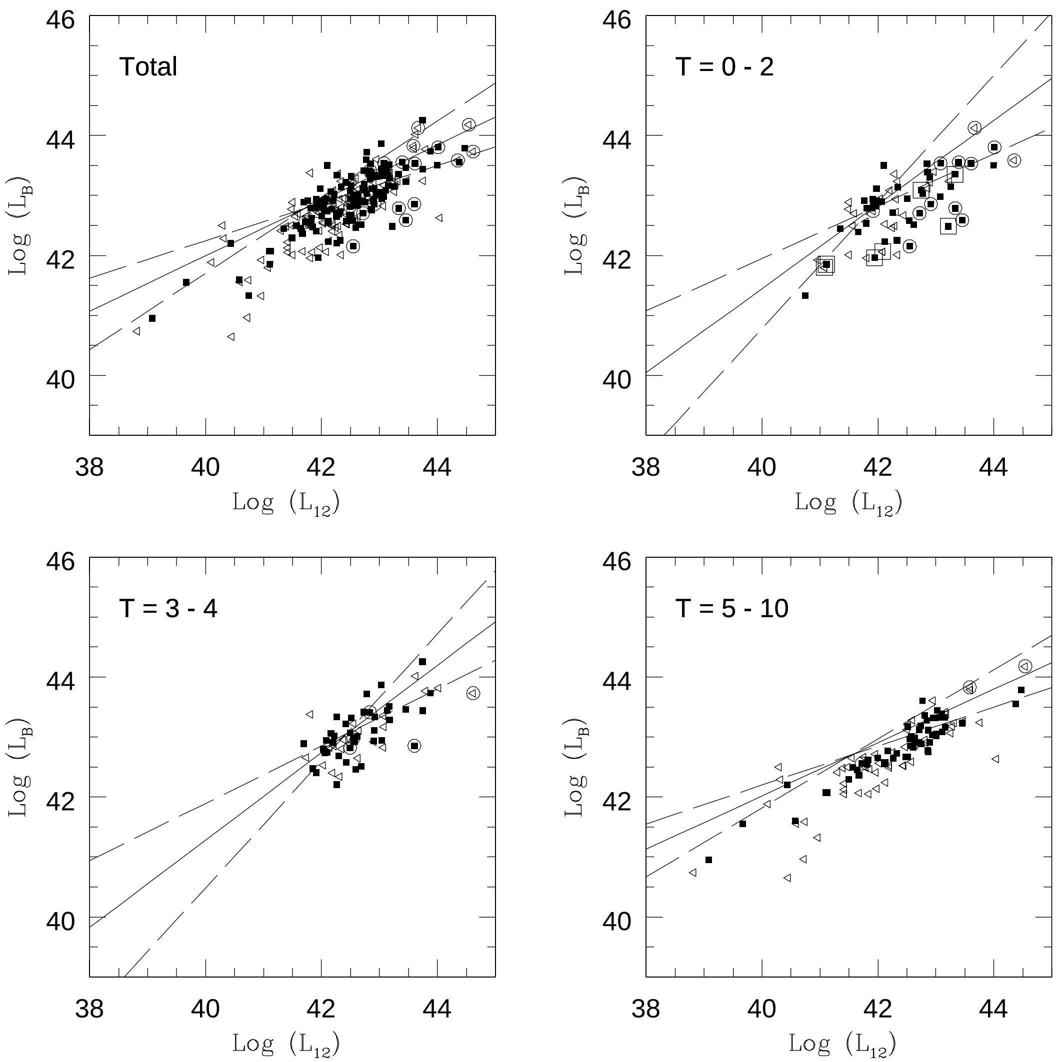

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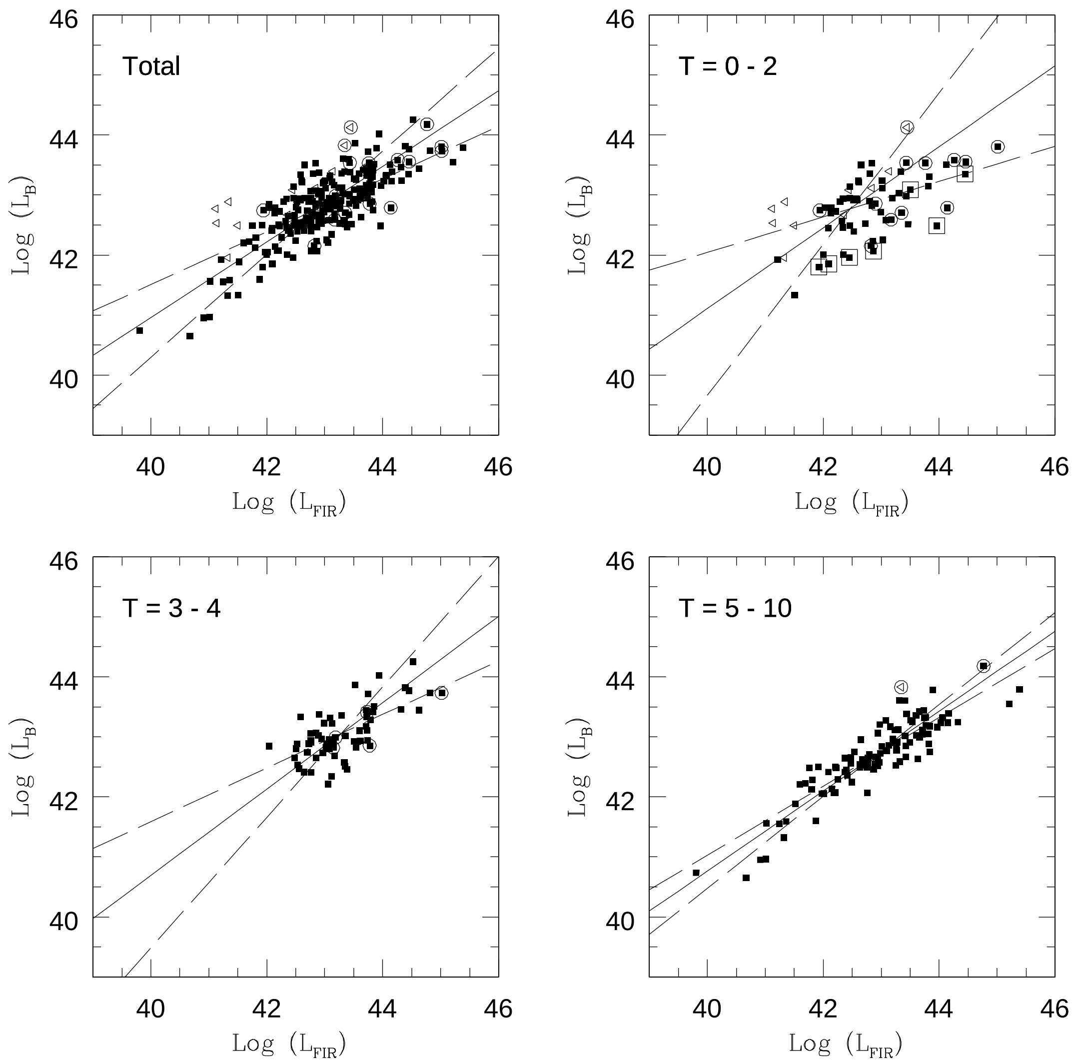

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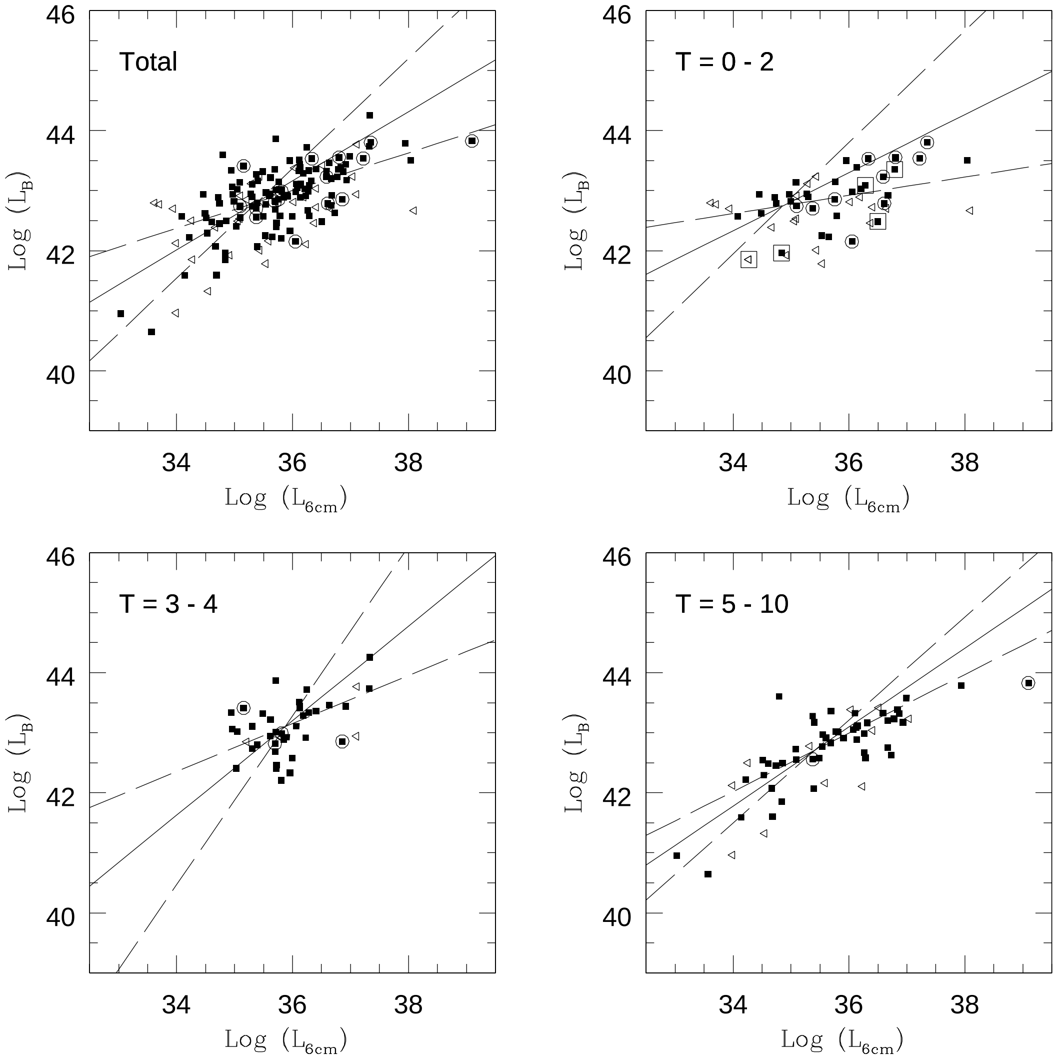

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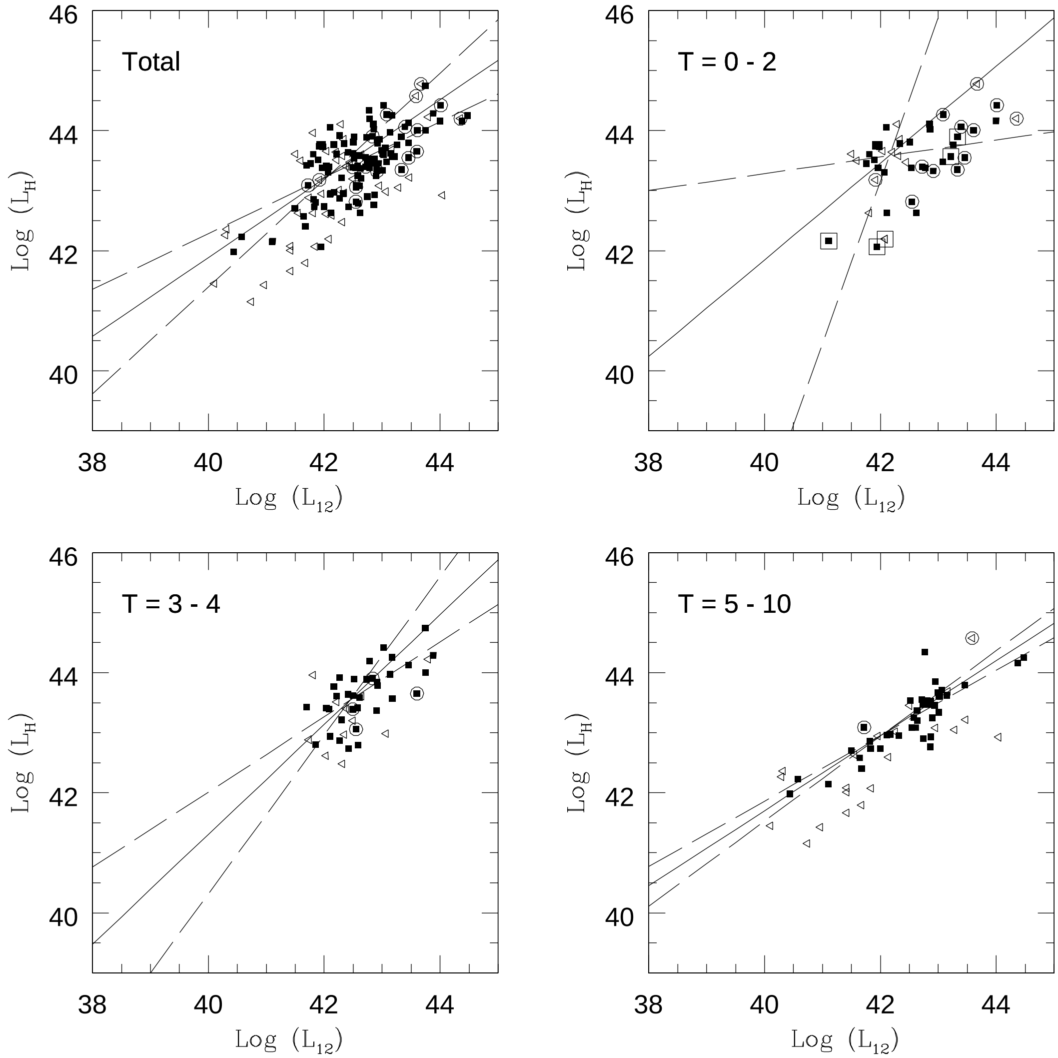

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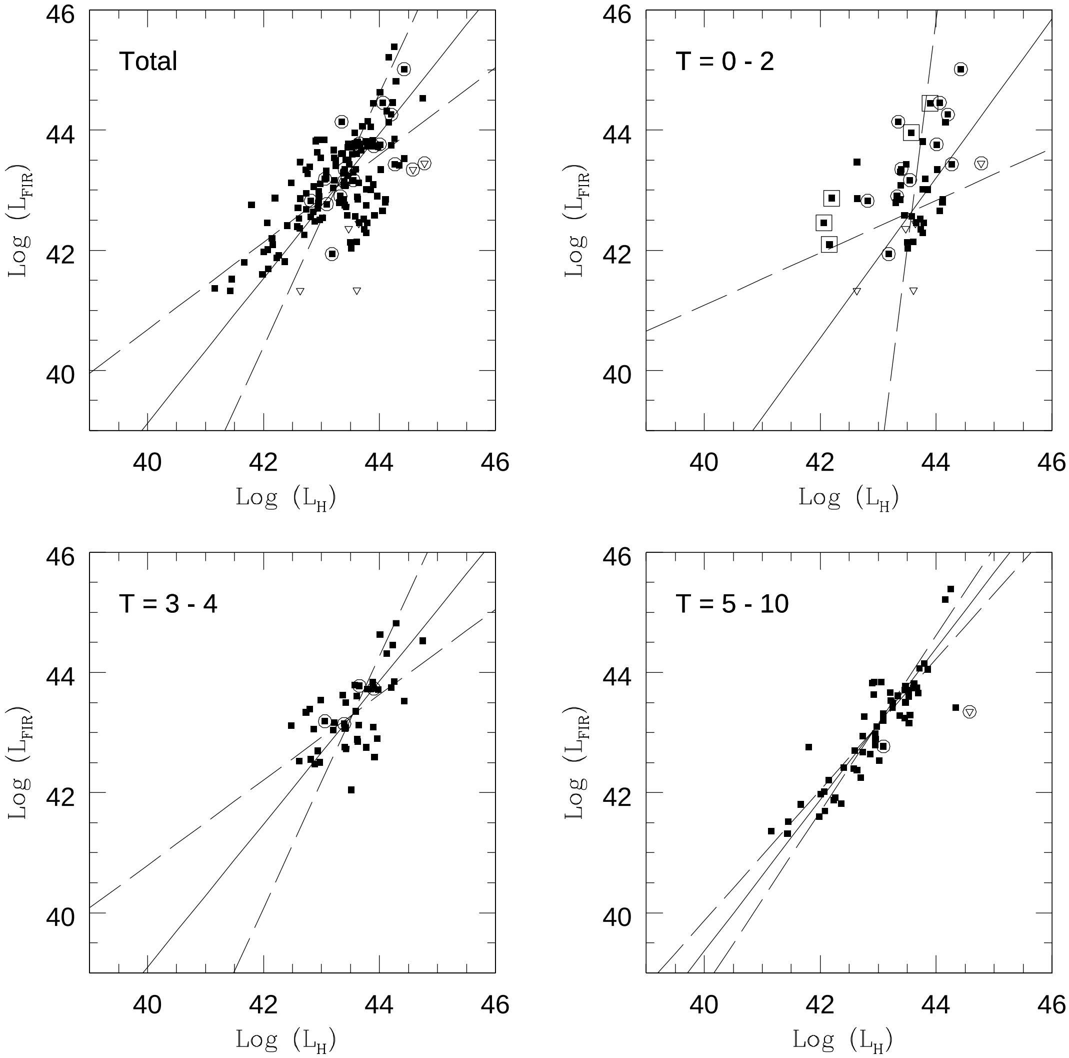

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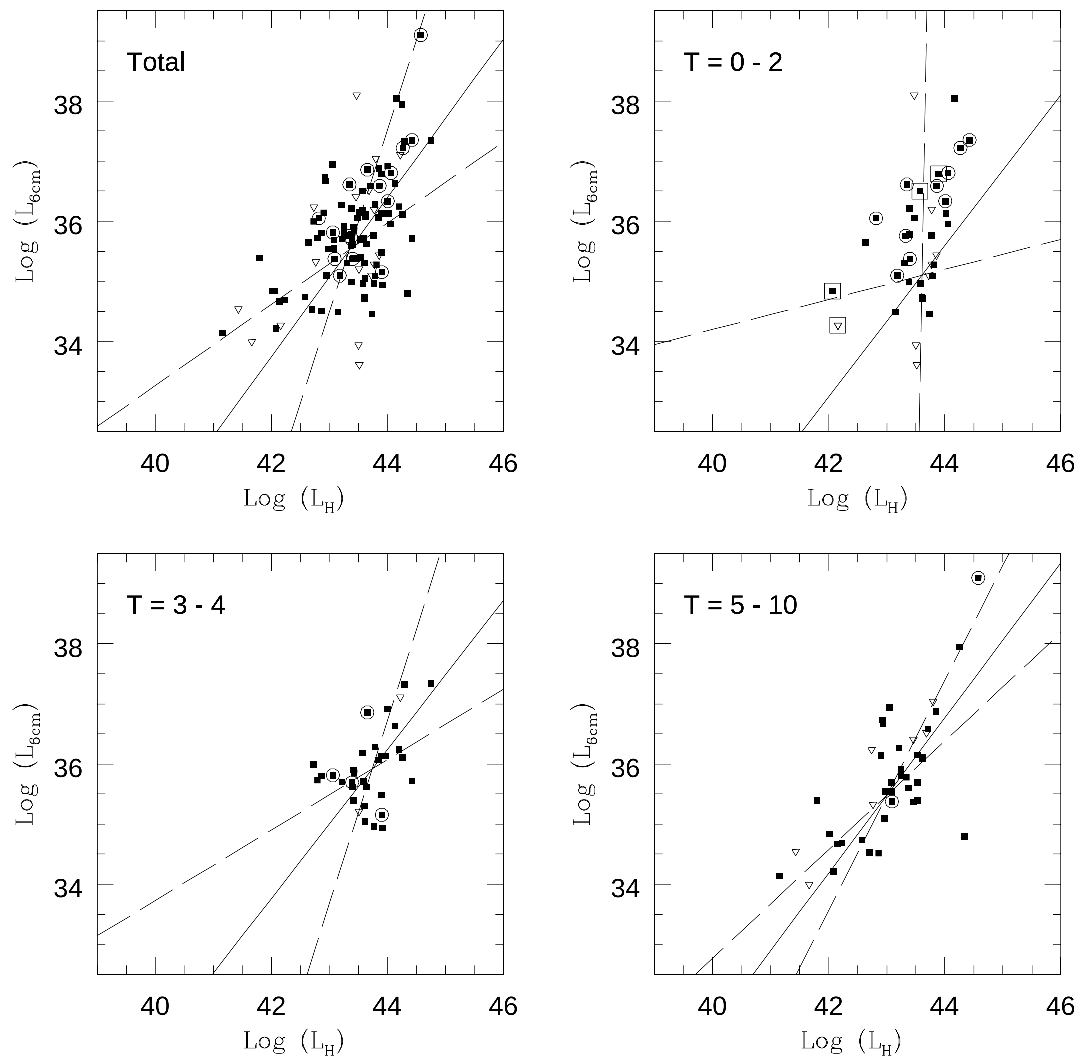

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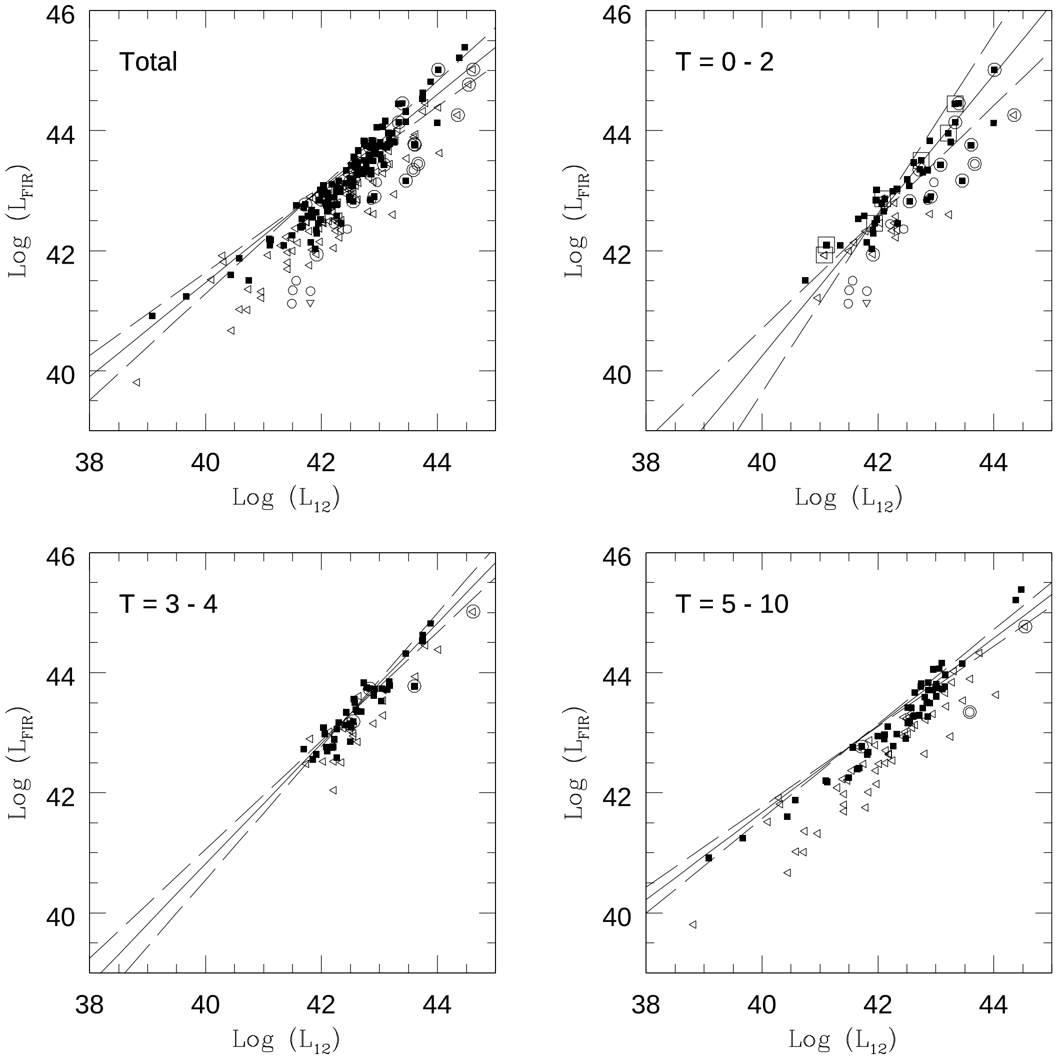

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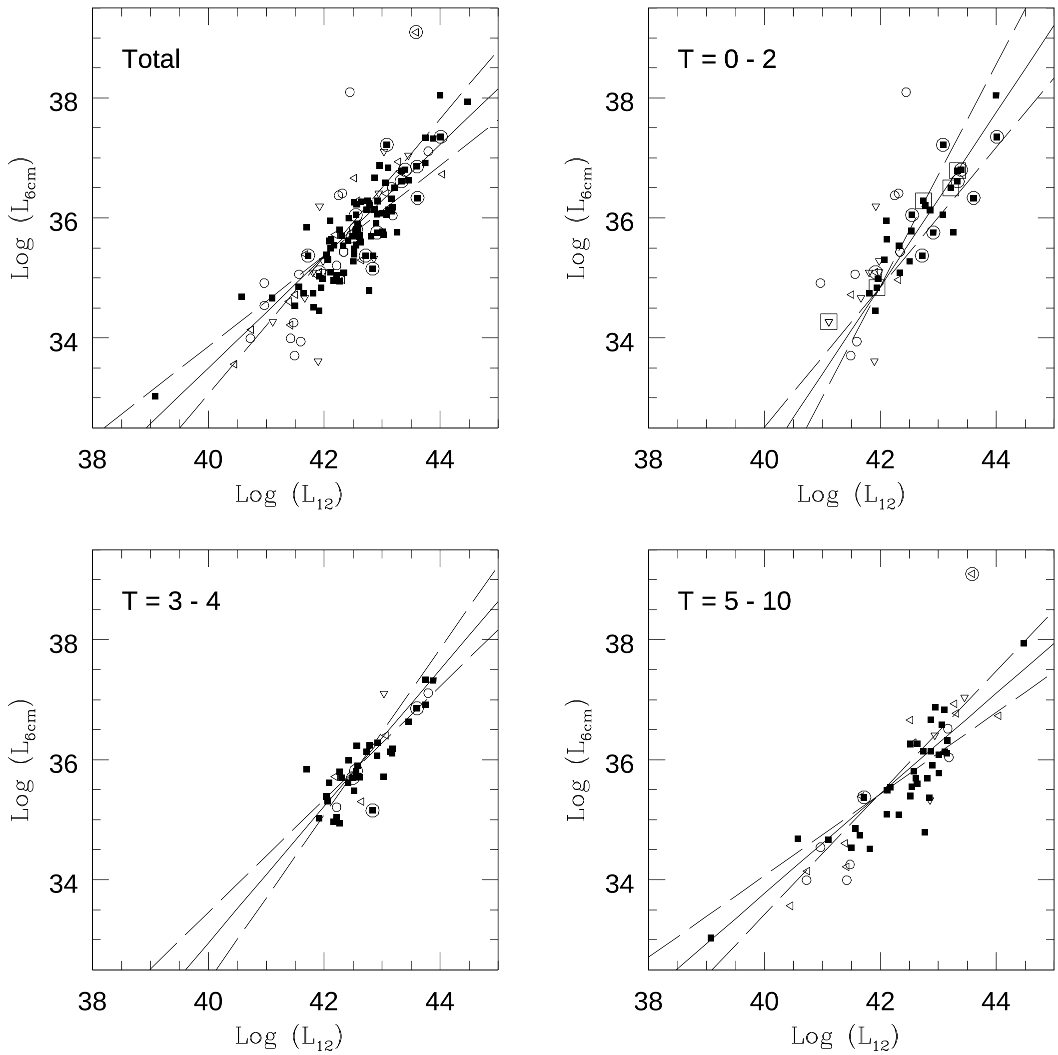

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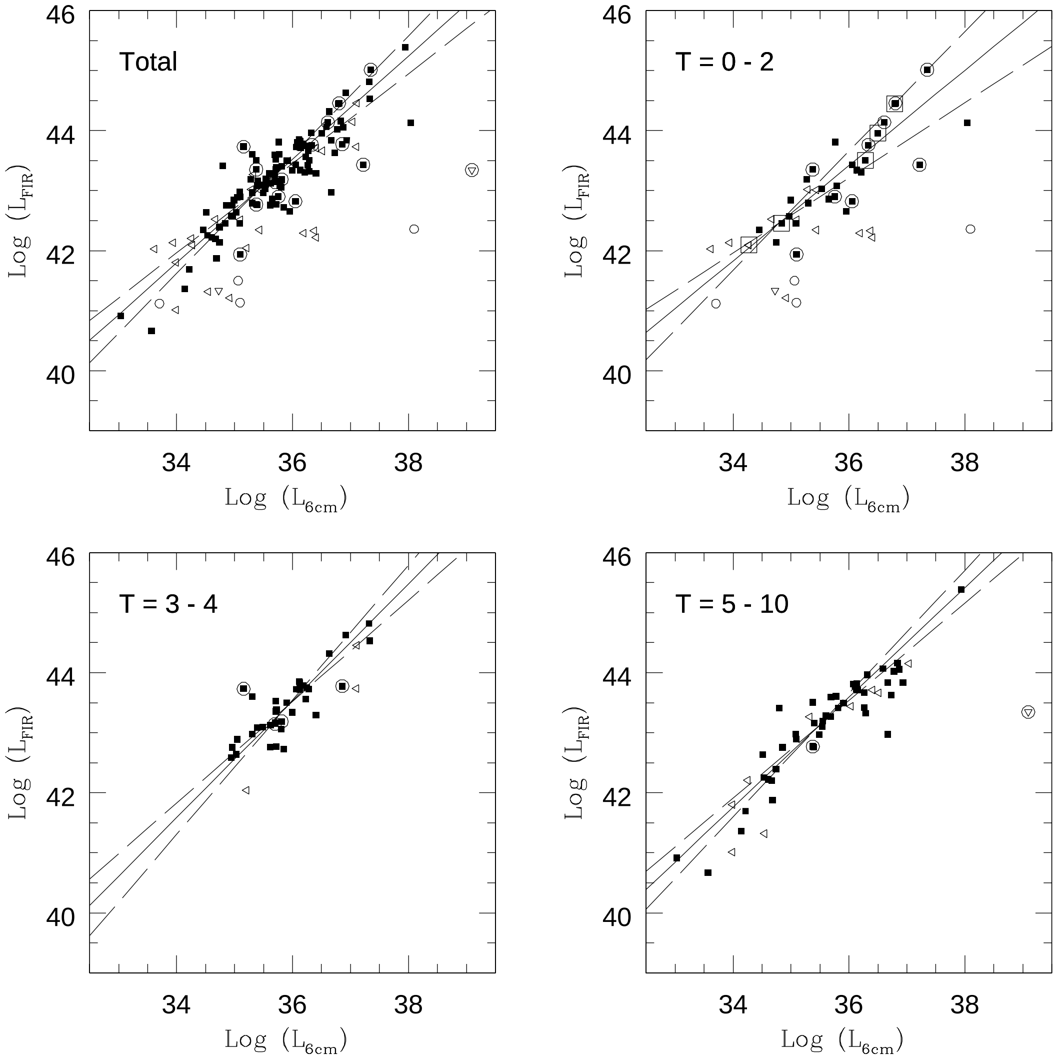

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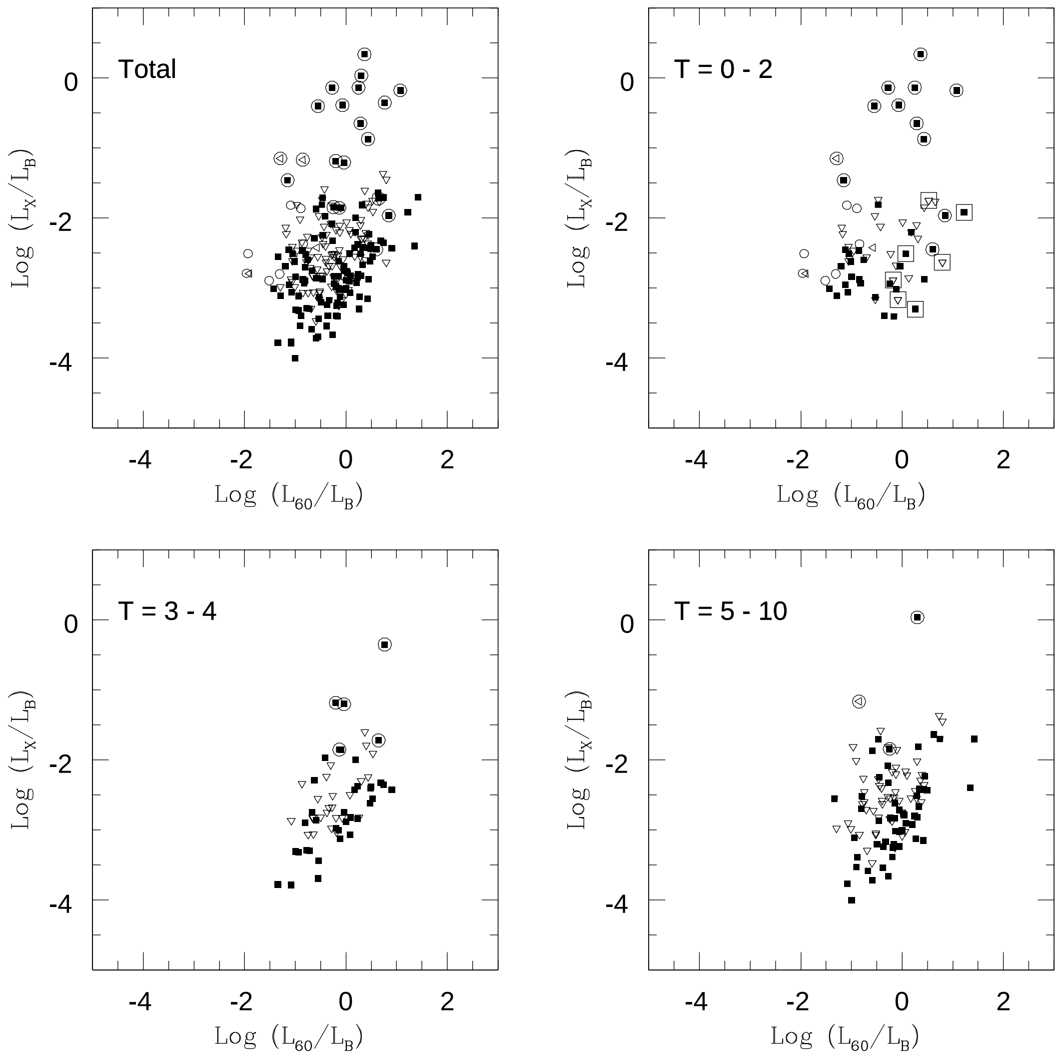
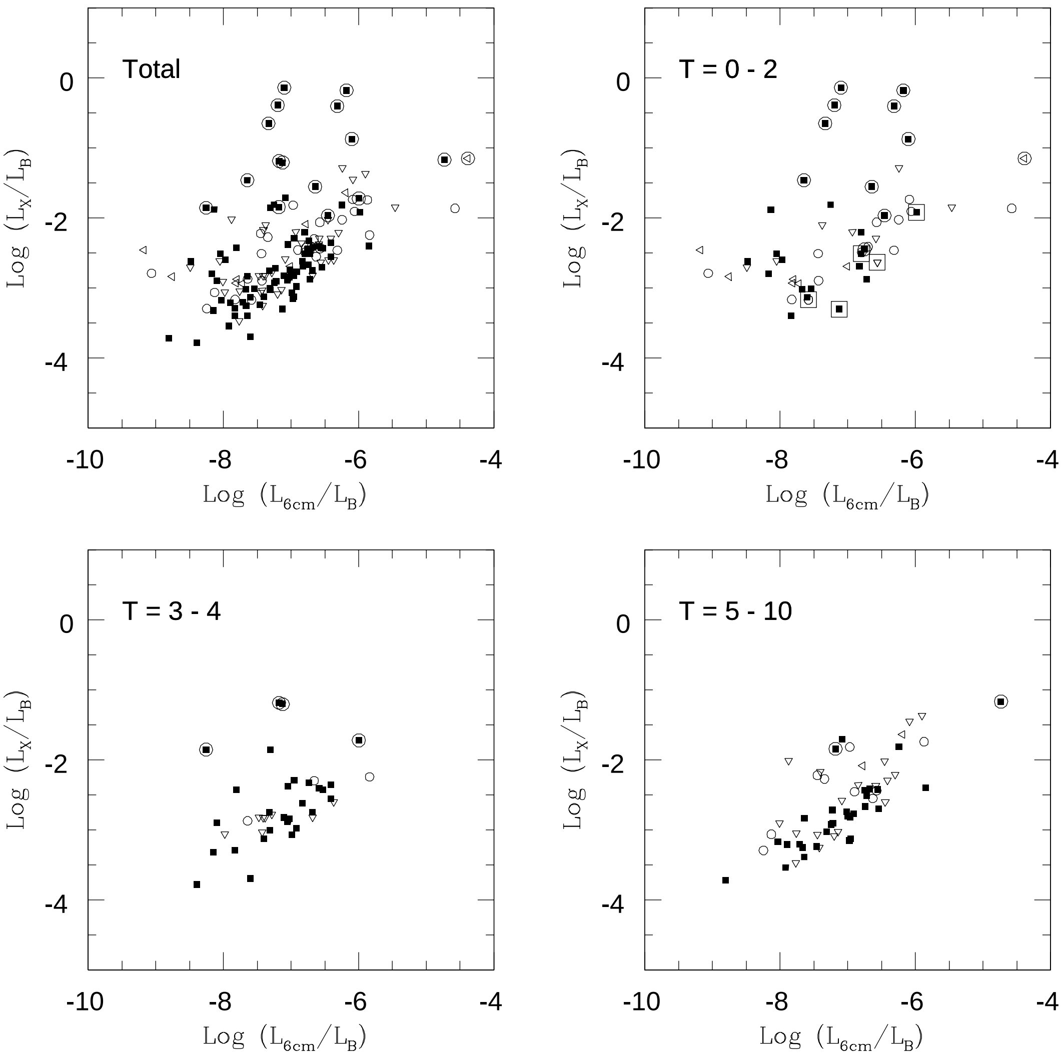


FIG. 7.—Scatter diagrams of log (L_X/L_B) vs. other luminosity ratios. For each pair, the scatter diagrams for the total sample and for the three morphological subsamples ("early," $T = 0$–2; "intermediate," $T = 3$–4; and "late," $T = 5$–10) are plotted. Filled squares identify detections on both axes; triangles identify upper limits in one of the axes, with the apex pointing in the direction of the limit; open circles identify upper limits in both axes; circles surrounding another symbol identify the flagged AGNs, which were not included in the statistical analysis; squares surrounding another symbol identify amorphous galaxies, which were not included in the $T = 0$–2 analysis.



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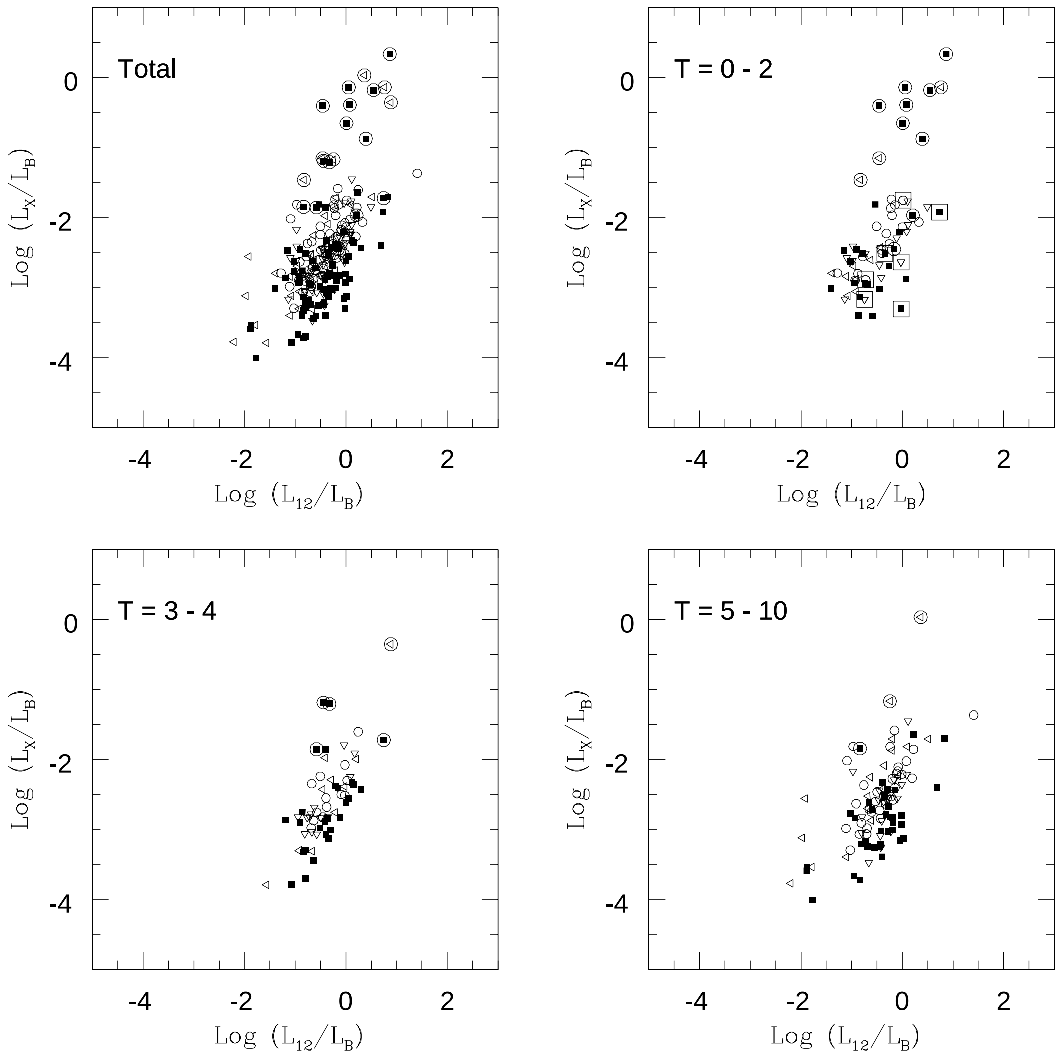

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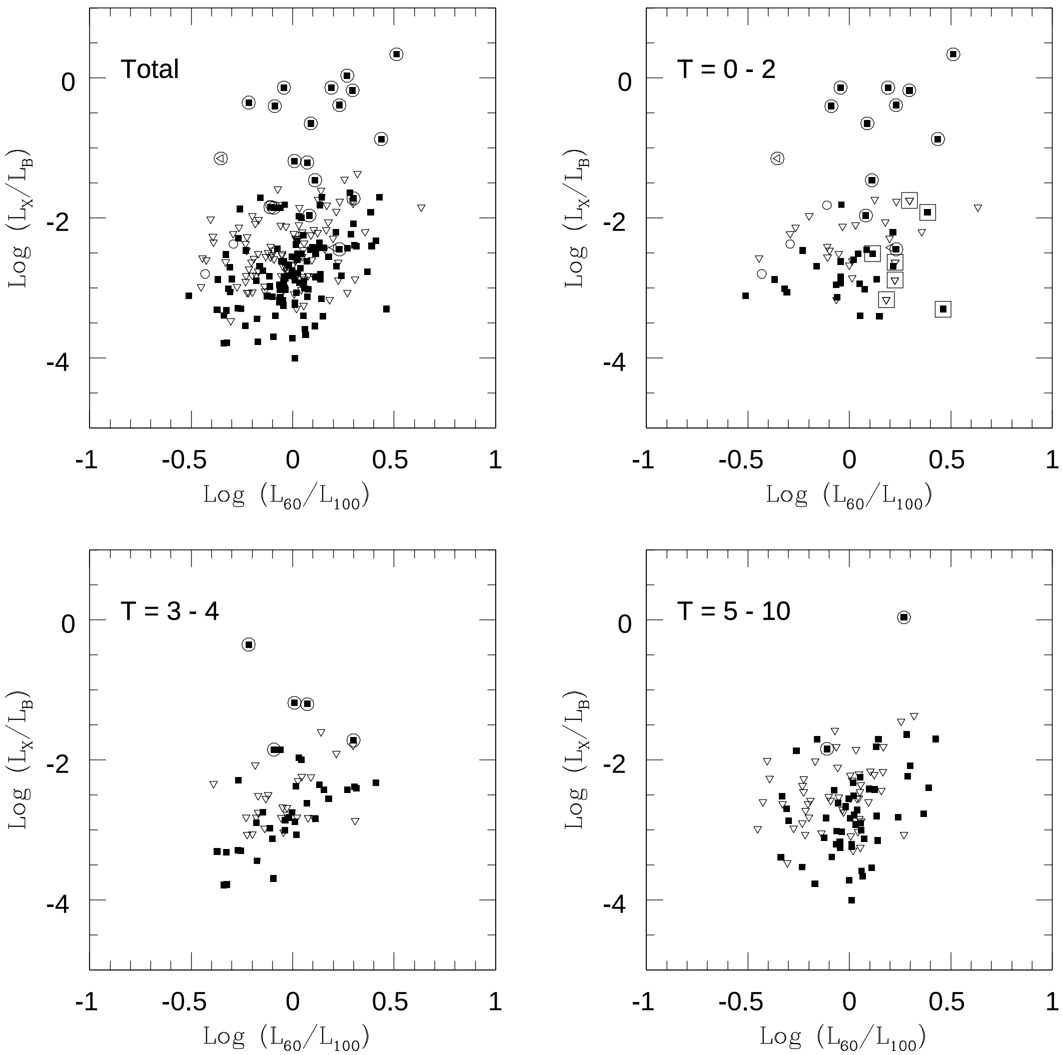

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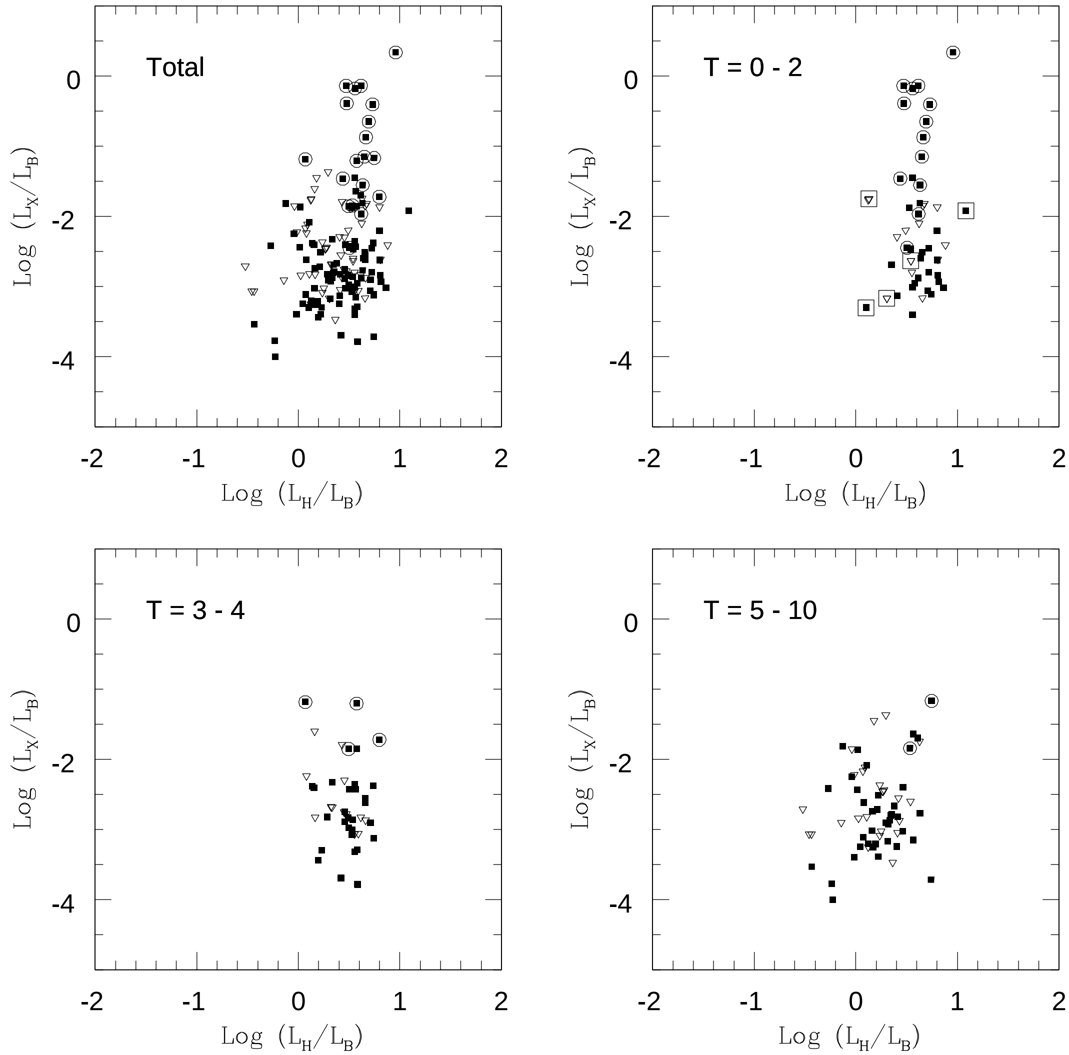

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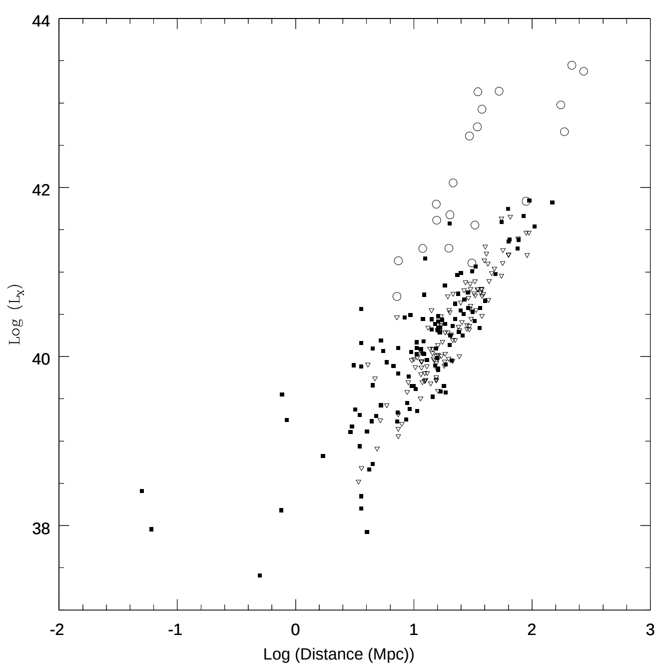

FIG. 8.—log L_X–log D scatter diagram for the total sample. Circles are AGN detections, squares are detections, and triangles are upper limits.

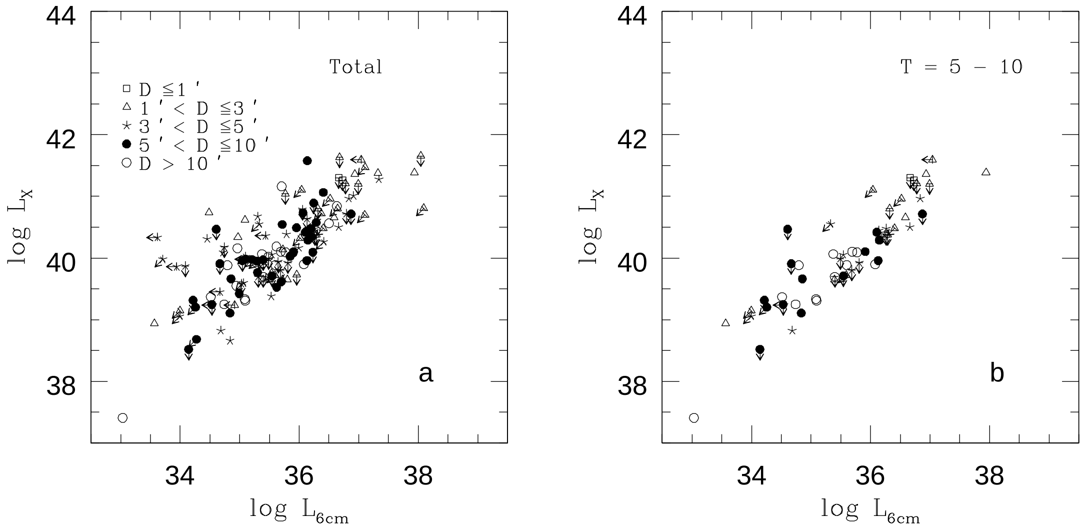

FIG. 9.—log L_X– log L_{6cm} scatter diagrams for the (*a*) total and (*b*) late $T = 5$–10 sample. Different symbols are used for different galaxy diameters; see (*a*). We do not detect any evident displacement of large-diameter galaxies.

6. BIVARIATE ANALYSIS

We report below the results of bivariate correlation tests and regression analysis for each of 15 luminosity pairs in the matrix of combinations among the six variables L_X, L_B, L_H, L_{12}, L_{FIR}, and $L_{6\ cm}$. After applying the same tests to correlations including each of the IR variables (L_{12}, L_{25}, L_{60}, and L_{100}), we concluded that 12 and 25 μm behave similarly and so we adopted L_{12} as representative of the mid-IR emission; the same is true for L_{60}, L_{100}, and L_{FIR} (which is a combination of the two). In addition, we report the results of correlation tests applied to the X-ray–to–optical ratio, L_X/L_B, and five other luminosity ratios: L_{60}/L_B, $L_{6\ cm}/L_B$, L_{12}/L_B, L_{60}/L_{100}, and L_H/L_B.

The bivariate package, BIVAR, in ASURV provides three methods for testing for the presence of a correlation between two variables containing censored data points: the Cox hazard model, the generalized Kendall's tau, and the Spearman's rho. Cox's hazard, a parametric method, i.e., one that requires certain assumptions with respect to the underlying distribution of the sampled data points, can only be used when there is one type of censoring (upper or lower limits), and when the censoring only occurs in the dependent variable. The other two methods, Kendall's tau and Spearman's rho, are nonparametric tests, operating on the basis of the sample values alone, without any assumptions regarding the underlying population. Both of the nonparametric tests can handle censoring in both the independent and dependent variable. Since many of the luminosity pairs under consideration contained upper limits in both variables, we could not apply the Cox method to these cases and simply used the Kendall and Spearman correlation tests. Wherever applicable, the Cox method gives results (not shown) consistent with those of the other two methods.

Table 4 displays the results of the bivariate luminosity correlation tests for the total ($T = 0$–10), early ($T = 0$–2), intermediate ($T = 3$–4), and late ($T = 5$–10) samples. For each test pair and sample are listed the following: the number of data points (N_{tot}); the number of upper limits (N_{lim}), in the order (1) limits on the first variable of the pair, (2) limits on the second variable, and (3) limits on both variables; the Kendall test statistic (τ_K) and corresponding probability of the correlation arising by chance (P_K); the Spearman's correlation coefficient (r_{SR}) and corresponding probability (P_{SR}).

All 15 pairs of luminosities are highly correlated in the total sample. All of the correlations are characterized by the probability $P \leq 10^{-6}$ that the null hypothesis of no correlation is true, except for the pair ($L_{6\ cm}$, L_H), which has a weaker correlation.

However, the results differ when we compare the three morphological subsamples. In the early ($T = 0$–2, S0/a–Sab) sample, the correlations among L_{12}, L_{FIR}, and $L_{6\ cm}$ are all very significant ($P \leq 10^{-6}$). Similarly strong are the correlations of L_B with L_X and L_H, while the (L_X, L_H) one is marginal. Typically, correlations among one of L_{12}, L_{FIR}, or $L_{6\ cm}$ with either L_B, L_X, or L_H are poor or absent.

In the intermediate ($T = 3$–4, Sb–Sbc) sample, strong correlations persist among L_{12}, L_{FIR}, and $L_{6\ cm}$ and between L_B and L_H; L_X is more strongly correlated with the IR than with either L_B or L_H. L_H is now significantly correlated with both L_{12} and L_{FIR}.

In the late ($T = 5$–10, Sc–Irr) sample, all the pairs of variables are very strongly correlated, with $P \leq 10^{-6}$.

Table 5 displays the results of the bivariate luminosity-ratio correlation tests for the total, early, intermediate, and late samples. The format is the same as for Table 4. As is the case for the luminosity correlations discussed above, we find morphology-related differences. In the total sample we find that X-ray brighter galaxies (for a given optical luminosity) are those brighter in the radio continuum, mid-IR, and far-IR, and with warmer far-IR colors. However, these color correlations only arise in the intermediate and late samples and are absent in the bulge-dominated early sample. As discussed in Paper II, these effects may all be related to star formation activity. They also reflect the existence of nonlinear power-law relations between the luminosities (see below).

Linear regression analysis was applied to bivariate correlations to estimate the functional relations between the variables. ASURV's BIVAR offers three routines for linear regression analysis of censored data: the estimation-maximization (EM) method, the Buckley-James method, and Schmitt's binning method (Schmitt 1985). The first two

TABLE 4

Correlation Tests (No Amorphous Galaxies)

	Total		$T = 0$–2		$T = 3$–4		$T = 5$–10	
Test Pair	N_{tot}[a]	N_{lim}[b]	N_{tot}[a]	N_{lim}[b]	N_{tot}[a]	N_{lim}[b]	N_{tot}[a]	N_{lim}[b]
L_X-L_B	234	120, 0, 0	58	32, 0, 0	61	28, 0, 0	108	56, 0, 0
	9.75125	0.000000	4.97458	0.000001	4.29697	0.000017	6.43196	0.000000
	0.63156	0.000000	0.64656	0.000001	0.55666	0.000016	0.58926	0.000000
L_X-L_H	140	53, 0, 0	32	11, 0, 0	41	14, 0, 0	62	25, 0, 0
	7.05771	0.000000	2.39037	0.016831	3.29027	0.001001	4.62693	0.000004
	0.59595	0.000000	0.45075	0.012085	0.49023	0.001932	0.56567	0.000010
L_X-L_{12}	218	44, 33, 64	51	12, 8, 15	58	13, 9, 13	102	17, 16, 34
	9.33129	0.000000	3.02355	0.002498	5.34773	0.000000	6.79409	0.000000
	0.56422	0.000000	0.34145	0.015760	0.62435	0.000002	0.58729	0.000000
L_X-L_{FIR}	218	101, 2, 7	51	20, 2, 7	58	26, 0, 0	102	51, 0, 0
	9.25571	0.000000	2.53401	0.011276	5.41846	0.000000	7.47039	0.000000
	0.59641	0.000000	0.34655	0.014265	0.71233	0.000000	0.67932	0.000000
L_X-$L_{6\ cm}$	136	34, 8, 25	38	7, 6, 12	36	8, 0, 3	57	18, 2, 9
	8.23522	0.000000	2.78807	0.005302	4.32718	0.000015	6.26258	0.000000
	0.59459	0.000000	0.37041	0.024252	0.66916	0.000075	0.64251	0.000002
L_B-L_H	140	0, 0, 0	32	0, 0, 0	41	0, 0, 0	62	0, 0, 0
	12.55309	0.000000	5.74062	0.000000	7.39062	0.000000	9.03216	0.000000
	0.88156	0.000000	0.86950	0.000001	0.94216	0.000000	0.93020	0.000000
L_B-L_{12}	218	0, 97, 0	51	0, 23, 0	58	0, 22, 0	102	0, 50, 0
	10.14752	0.000000	3.80753	0.000140	4.15996	0.000032	8.31032	0.000000
	0.62615	0.000000	0.50178	0.000388	0.49103	0.000210	0.71452	0.000000
L_B-L_{FIR}	218	0, 9, 0	51	0, 9, 0	58	0, 0, 0	102	0, 0, 0
	11.43934	0.000000	3.63036	0.000283	4.63522	0.000004	10.38866	0.000000
	0.70124	0.000000	0.49978	0.000409	0.59808	0.000006	0.87139	0.000000
L_B-$L_{6\ cm}$	136	0, 33, 0	38	0, 18, 0	36	0, 3, 0	57	0, 11, 0
	7.35568	0.000000	3.54014	0.000400	2.54202	0.011021	5.30613	0.000000
	0.61265	0.000000	0.60167	0.000252	0.43516	0.010040	0.64744	0.000001
L_H-L_{12}	135	0, 41, 0	30	0, 9, 0	41	0, 11, 0	59	0, 20, 0
	6.61906	0.000000	0.85766	0.391081	3.76223	0.000168	6.95073	0.000000
	0.56200	0.000000	0.17853	0.336336	0.58141	0.000236	0.81725	0.000000
L_H-L_{FIR}	135	0, 4, 0	30	0, 4, 0	41	0, 0, 0	59	0, 0, 0
	6.17389	0.000000	0.77468	0.438528	3.81886	0.000134	7.42232	0.000000
	0.49702	0.000000	0.14314	0.440811	0.58328	0.000225	0.82636	0.000000
L_H-$L_{6\ cm}$	97	0, 17, 0	24	0, 7, 0	29	0, 2, 0	40	0, 7, 0
	4.13407	0.000036	1.44578	0.148239	1.66752	0.095411	3.86312	0.000112
	0.41224	0.000054	0.33915	0.103842	0.31874	0.091681	0.56935	0.000377
L_{12}-L_{FIR}	218	89, 1, 8	51	15, 1, 8	58	22, 0, 0	102	50, 0, 0
	14.70804	0.000000	6.98218	0.000000	7.47427	0.000000	10.00862	0.000000
	0.83149	0.000000	0.87383	0.000000	0.83006	0.000000	0.82432	0.000000
L_{12}-$L_{6\ cm}$	125	15, 11, 17	32	2, 6, 9	35	3, 1, 2	53	10, 3, 6
	10.39708	0.000000	5.64062	0.000000	5.82150	0.000000	5.82509	0.000000
	0.77305	0.000000	0.84709	0.000002	0.82883	0.000001	0.64624	0.000003
L_{FIR}-$L_{6\ cm}$	125	1, 24, 4	32	1, 11, 4	35	0, 3, 0	53	0, 9, 0
	11.41265	0.000000	4.74208	0.000002	5.66011	0.000000	7.45396	0.000000
	0.85204	0.000000	0.78785	0.000012	0.81729	0.000002	0.82862	0.000000

[a] The values in rows 2 and 3 of each group are the test statistic for the Kendall τ correlation test and the Spearman rank correlation coefficient, respectively.

[b] The three values for N_{lim} in the first row of each group in these columns are, respectively, the number of limit points in the left-hand luminosity, the number in the right-hand luminosity, and the number of double limits. The numbers listed in rows 2 and 3 of each group are the probabilities that the two luminosities are uncorrelated.

methods only handle data sets that possess censoring in the dependent variable alone. Schmitt's method, however, addresses the problem of censoring in both variables. Thus, for many of the luminosity pairs with censoring in both variables, we were able to apply only Schmitt's method to perform regression analysis. We note, however, that we found very good agreement among the three regression methods for the luminosity pairs with censoring such that we were able to apply all three. Instead of defining one variable as "independent" and the other as "dependent," for each luminosity pair, (X, Y), in each morphological subgroup, we obtained the Schmitt's method regression coefficients (slope, intercept, and the uncertainties in these quantities) for both $(X\,|\,Y)$ and $(Y\,|\,X)$. We then used the bisector of these regressions as our final estimate of the linear relationship between the variables (Isobe et al. 1990). Appendix B discusses the derivation of these bisectors. We did not apply this same analysis to the luminosity ratios because, while the luminosity-ratio pairs display signals of gross correlation, there is a lot more scatter present in these

TABLE 5

CORRELATION TESTS BETWEEN L_X/L_B AND OTHER LUMINOSITY RATIOS (NO AMORPHOUS GALAXIES)

RATIO	TOTAL N_{tot}[a]	TOTAL N_{lim}[b]	$T = 0$–2 N_{tot}[a]	$T = 0$–2 N_{lim}[b]	$T = 3$–4 N_{tot}[a]	$T = 3$–4 N_{lim}[b]	$T = 5$–10 N_{tot}[a]	$T = 5$–10 N_{lim}[b]
L_{60}/L_B	217	2, 100, 7	51	2, 20, 7	57	0, 25, 0	102	0, 51, 0
	4.91099	0.000001	0.01669	0.986687	4.19187	0.000028	4.18877	0.000028
	0.32989	0.000001	−0.00197	0.988912	0.57721	0.000016	0.42647	0.000018
$L_{6\ cm}/L_B$	136	8, 34, 25	38	6, 7, 12	36	0, 8, 3	57	2, 18, 9
	5.66497	0.000000	0.61730	0.537040	3.64839	0.000264	5.00346	0.000000
	0.41897	0.000001	0.03927	0.811206	0.61129	0.000299	0.57013	0.000020
L_{12}/L_B	218	33, 44, 64	51	8, 12, 15	58	9, 13, 13	102	16, 17, 34
	4.73124	0.000002	0.67962	0.496746	3.68214	0.000231	3.29762	0.000975
	0.29226	0.000017	0.06183	0.661981	0.45932	0.000525	0.31743	0.001422
L_{60}/L_{100}	212	1, 100, 3	46	1, 20, 3	58	0, 26, 0	101	0, 50, 0
	4.76055	0.000002	1.33388	0.182243	3.99922	0.000064	2.99848	0.002713
	0.30122	0.000012	0.16779	0.260355	0.52355	0.000077	0.27794	0.005446
L_H/L_B	140	0, 53, 0	32	0, 11, 0	41	0, 14, 0	62	0, 25, 0
	1.80598	0.070921	0.48752	0.625893	0.38805	0.697983	0.90487	0.365536
	0.17401	0.040214	−0.05096	0.776608	−0.03619	0.818938	0.14835	0.246597

[a] The values in rows 2 and 3 of each group are the test statistic for the Kendall τ correlation test and the Spearman rank correlation coefficient, respectively.

[b] The three values for N_{lim} in the first row of each group in these columns are, respectively, the number of limit points in the luminosity ratio paired with L_X/L_B, the number in L_X/L_B, and the number of double limits. The numbers listed in rows 2 and 3 of each group are the probabilities that the two variables are uncorrelated.

correlations than in the correlations between luminosities, inducing a large uncertainty into any obtained value of regression slope.

The power-law dependencies of the bivariate correlations between each pair of luminosities are given by the slopes of the regression bisectors, which are tabulated in Table 6, together with an estimate of their uncertainty (σ_{Slope}) and the intercepts of the bisectors. These bisector lines, along with the regression lines, are plotted on the scatter diagrams of Figure 6. Inspection of the regression bisectors reveals that (1) different luminosity pairs are described by different power-law relationships and (2) the power-law relationship for a given luminosity pair may be a function of morphological type.

In the total sample, the regression bisectors for the correlations between X-ray, H, far-IR, and radio continuum luminosities are consistent (within 2 σ) with linear relations, i.e., all these luminosities increase in parallel. Other correlations are definitely nonlinear. These include among others the well-known $L_B \propto L_H^{0.7}$ relation (Aaronson et al. 1979) and the strong linear FIR/radio continuum correlation (Dickey & Salpeter 1984; Helou et al. 1985; de Jong et al. 1985). These results are in agreement with previous studies of large different representative samples of spiral galaxies and reinforce our conclusion of § 2 that our sample is representative of the spiral galaxy population. In disagreement with previous reports, we find $L_X \propto L_B^{1.5}$, steeper than the relation reported between these two quantities in Fabbiano et al. (1988), which, however, was based on the analysis of a much smaller sample of 51 galaxies. We will discuss the implications of this result in Paper II. We suggest there that different mechanisms may be responsible for these effects in

TABLE 6

SCHMITT'S METHOD REGRESSION BISECTORS (NO AMORPHOUS GALAXIES)

X	Y	TOTAL Slope	TOTAL σ_{Slope}	TOTAL Intercept	$T = 0$–2 Slope	$T = 0$–2 σ_{Slope}	$T = 0$–2 Intercept	$T = 3$–4 Slope	$T = 3$–4 σ_{Slope}	$T = 3$–4 Intercept	$T = 5$–10 Slope	$T = 5$–10 σ_{Slope}	$T = 5$–10 Intercept
L_B	L_X	1.50	0.10	−24.34	1.45	0.15	−22.03	1.53	0.17	−26.03	1.48	0.13	−23.61
L_H	L_X	1.17	0.08	−10.67	1.41	0.47	−21.38	1.10	0.22	−7.87	1.20	0.13	−12.03
L_{12}	L_X	0.74	0.07	8.53	1.22	0.16	−11.64	1.07	0.09	−5.17	0.66	0.06	12.26
L_{FIR}	L_X	1.00	0.06	−3.16	0.84	0.14	4.18	1.10	0.10	−7.51	0.96	0.06	−1.60
$L_{6\ cm}$	L_X	0.90	0.07	7.77	0.65	0.13	17.19	0.96	0.12	5.75	0.90	0.07	7.70
L_H	L_B	0.73	0.03	11.46	1.00	0.11	−0.49	0.83	0.06	6.78	0.73	0.04	11.34
L_{12}	L_B	0.49	0.04	22.51	0.75	0.09	11.27	0.76	0.09	10.92	0.45	0.04	23.99
L_{FIR}	L_B	0.65	0.04	14.95	0.64	0.13	15.61	0.78	0.14	9.36	0.66	0.04	14.34
$L_{6\ cm}$	L_B	0.53	0.05	24.18	0.50	0.12	25.27	0.65	0.16	19.74	0.62	0.07	20.64
L_{12}	L_H	0.67	0.06	15.02	0.82	0.28	9.04	0.84	0.12	7.91	0.60	0.05	17.89
L_H	L_{FIR}	1.16	0.13	−7.24	1.30	0.66	−14.01	1.20	0.24	−8.77	1.19	0.09	−7.99
L_H	$L_{6\ cm}$	1.38	0.21	−24.17	2.32	1.03	−66.37	1.43	0.56	−26.54	1.25	0.23	−18.27
L_{12}	L_{FIR}	0.76	0.04	10.95	1.23	0.12	−9.23	0.98	0.07	1.84	0.74	0.03	11.99
L_{12}	$L_{6\ cm}$	0.99	0.07	−6.08	1.79	0.21	−40.60	1.15	0.12	−13.03	0.88	0.07	−1.37
$L_{6\ cm}$	L_{FIR}	0.82	0.05	14.16	0.72	0.13	17.30	0.92	0.09	10.56	0.91	0.06	10.67

TABLE 7

SPEARMAN PARTIAL RANK ANALYSIS

		TOTAL ($N = 94$)			T = 0–2 ($N = 23$)			T = 3–4 ($N = 29$)			T = 5–10 ($N = 38$)		
TEST PAIR	HELD PARAMETERS	Partial Rank	Test Stat. (T)	Prob.	Partial Rank	Test Stat. (T)	Prob.	Partial Rank	Test Stat. (T)	Prob.	Partial Rank	Test Stat. (T)	Prob.
B, X	6 cm, *H*, FIR, 12, *D*	−0.007	−0.068	>0.400	0.097	0.388	0.354	−0.095	−0.449	0.330	0.239	1.368	0.093
H, X	6 cm, *B*, FIR, 12, *D*	0.210	2.005	0.025	0.185	0.751	0.236	0.104	0.491	0.314	−0.275	−1.594	0.064
X, 12	6 cm, *H*, *B*, FIR, *D*	0.060	0.563	0.289	0.168	0.683	0.252	0.232	1.121	0.147	0.077	0.428	0.338
X, FIR	6 cm, *H*, *B*, 12, *D*	−0.021	−0.197	>0.400	−0.267	−1.108	0.154	0.214	1.026	0.170	0.258	1.487	0.077
6 cm, X	*H*, *B*, FIR, 12, *D*	0.250	2.404	0.010	0.127	0.513	0.310	−0.023	−0.110	>0.400	0.141	0.795	0.223
H, *B*	6 cm, X, FIR, 12, *D*	0.819	13.307	<0.005	0.779	4.963	<0.005	0.934	12.253	<0.005	0.870	9.846	<0.005
B, 12............	6 cm, *H*, X, FIR, *D*	0.007	0.069	>0.400	0.033	0.131	>0.400	0.113	0.536	0.298	−0.144	−0.811	0.219
B, FIR	6 cm, *H*, X, 12, *D*	0.293	2.863	<0.005	0.141	0.572	0.289	0.166	0.789	0.226	0.081	0.455	0.328
6 cm, *B*.........	*H*, X, FIR, 12, *D*	−0.012	−0.114	>0.400	0.195	0.796	0.225	−0.129	−0.610	0.275	−0.040	−0.225	>0.400
H, 12	6 cm, *B*, X, FIR, *D*	0.143	1.352	0.093	−0.066	−0.264	0.399	0.036	0.171	>0.400	0.311	1.824	0.041
H, FIR	6 cm, *B*, X, 12, *D*	−0.255	−2.464	0.009	−0.082	−0.328	0.376	−0.137	−0.646	0.264	0.124	0.697	0.246
6 cm, *H*	*B*, X, FIR, 12, *D*	−0.108	−1.009	0.170	−0.111	−0.447	0.333	−0.023	−0.109	>0.400	−0.068	−0.378	0.356
FIR, 12.........	6 cm, *H*, *B*, X, *D*	0.632	7.602	<0.005	0.715	4.086	<0.005	0.370	1.868	0.039	0.509	3.288	<0.005
6 cm, 12........	*H*, *B*, X, FIR, *D*	0.241	2.318	0.013	0.449	2.008	0.033	0.665	4.177	<0.005	−0.046	−0.259	>0.400
6 cm, FIR......	*H*, *B*, X, 12, *D*	0.359	3.589	<0.005	0.082	0.329	0.375	0.157	0.747	0.237	0.503	3.241	<0.005

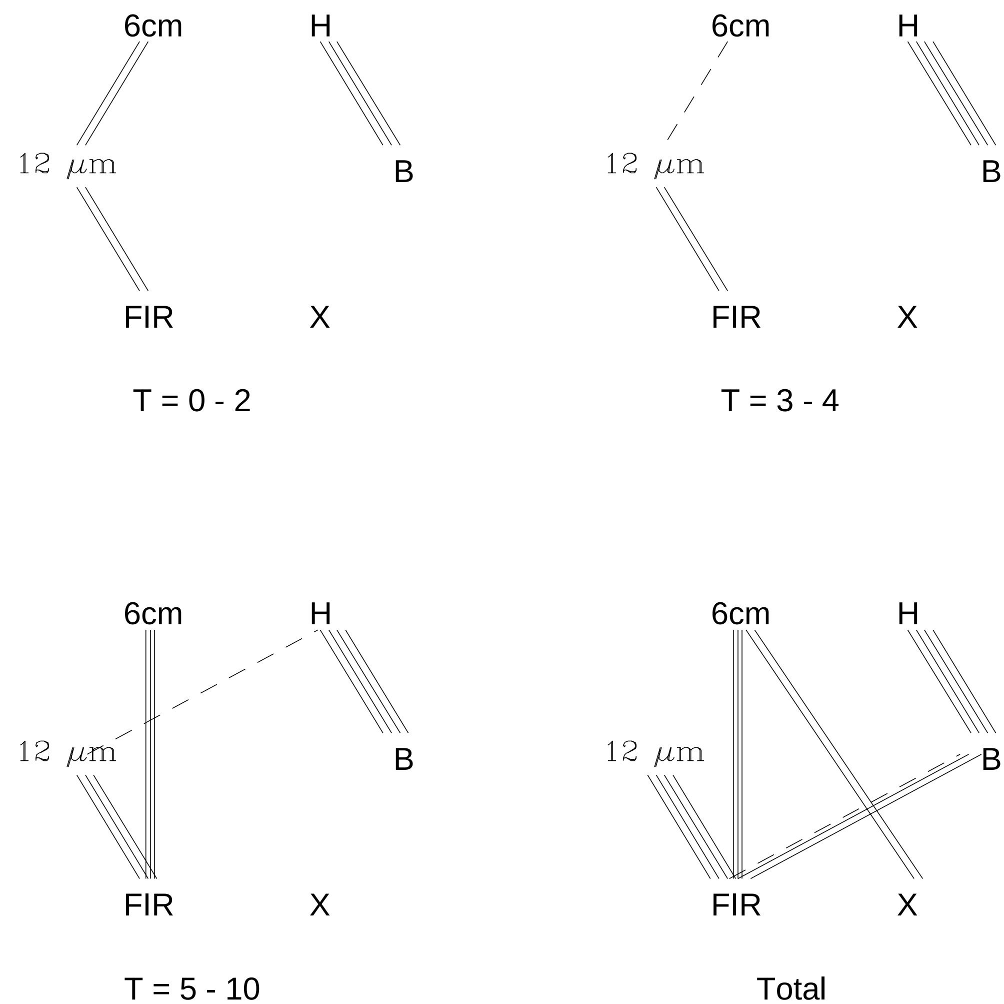

FIG. 10.—Graphical representation of the partial Spearman rank analysis. Significant correlations are represented by lines connecting the variables, with a greater number of connecting lines identifying relatively stronger correlations. Detailed test results are given in Table 7. We show diagrams for the three morphological subsamples ("early," $T = 0$–2; "intermediate," $T = 3$–4; and "late," $T = 5$–10) and for the total sample.

early- and late-type spirals: hot halos in bulge-dominated galaxies and obscuration effects in disk-dominated galaxies and irregulars.

Table 6 shows some morphology-related changes in the relation slopes. The best-defined bisectors are in the late sample, where all of the correlations are very significant. The results of the regression analysis include regression bisectors that are consistent with a power-law exponent $\alpha \approx 1$ for the following luminosity pairs: ($L_{\rm X}$, $L_{\rm FIR}$), ($L_{\rm FIR}$, $L_{6\,\rm cm}$), ($L_{\rm X}$, $L_{6\,\rm cm}$), ($L_{6\,\rm cm}$, L_{12}), and ($L_{\rm X}$, L_H). ($L_{6\,\rm cm}$, L_H) could also be consistent with a linear trend, but the error is significantly larger for this correlation. The other pairs exhibit relationships with power laws significantly different from unity. These relationships and their possible implications are discussed in Paper II. We conclude there that the linear relations are likely to result from the overall connection of those emission bands to star formation–related phenomena. The nonlinear relations point to other effects, including extinction and possibly the characteristics of the star formation history.

For certain pairs of luminosities, the distribution of early- and intermediate-type galaxies spans a smaller range in luminosity (typically restricted to higher luminosities) than does the distribution of late-type galaxies. To derive correlation and regression coefficients, we simply used all the available data, for each morphological subsample, regardless of luminosity range. This approach leads to the question of whether the differences in regression slope that we found for different morphological samples [e.g., in the ($L_{\rm FIR}$, L_{12}) correlation] may be only an artifact of the different ranges in luminosity that the different samples span. In Paper II we address explicitly this question in the cases in which the results may be affected, by analyzing the data in restricted luminosity ranges.

7. MULTIVARIATE ANALYSIS

We applied the partial Spearman rank analysis to all of the groups of three, four, five, and six variables that can be formed from $L_{\rm X}$, L_B, L_H, L_{12}, $L_{\rm FIR}$, and $L_{6\,\rm cm}$. We also held explicitly fixed the distance (D), to verify that our results are not affected by a distance bias.

The samples used for the multivariate analysis are smaller than those used to conduct bivariate correlations and regressions because we were restricted to include only those galaxies with data for all six variables. The results for the six-variable tests are given in Table 7. Results for smaller groupings of variables are tabulated in Appendix C. Table 7

TABLE 8

SIX-VARIABLE PARTIAL RANKS PLUS FIXED DISTANCE (TOTAL SAMPLE: $N = 94$)

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
6 cm, H	B , X, FIR, 12	−0.089	−0.840	0.211
6 cm, H	B, X, FIR, 12, D	−0.108	−1.009	0.170
6 cm, B	H, X, FIR, 12	−0.016	−0.147	>0.400
6 cm, B	H, X, FIR, 12, D	−0.012	−0.114	>0.400
6 cm, X	H, B, FIR, 12	0.301	2.964	<0.005
6 cm, X	H, B, FIR, 12, D	0.250	2.404	0.010
6 cm, FIR	H, B, X, 12	0.411	4.233	<0.005
6 cm, FIR	H, B, X, 12, D	0.359	3.589	<0.005
6 cm, 12	H, B, X, FIR	0.215	2.064	0.023
6 cm, 12	H, B, X, FIR, D	0.241	2.318	0.013
H, B	6 cm, X, FIR, 12	0.823	13.578	<0.005
H, B	6 cm, X, FIR, 12, D	0.819	13.307	<0.005
H, X	6 cm, B, FIR, 12	0.247	2.392	0.010
H, X	6 cm, B, FIR, 12, D	0.210	2.005	0.025
H, FIR	6 cm, B, X, 12	−0.236	−2.282	0.015
H, FIR	6 cm, B , X, 12, D	−0.255	−2.464	0.009
H, 12	6 cm, B, X, FIR	0.122	1.158	0.134
H, 12	6 cm, B, X, FIR, D	0.143	1.352	0.093
B, X	6 cm, H, FIR, 12	−0.012	−0.115	>0.400
B, X	6 cm, H, FIR, 12, D	−0.007	−0.068	>0.400
B, FIR	6 cm, H, X, 12	0.296	2.911	<0.005
B, FIR	6 cm, H, X, 12, D	0.293	2.863	<0.005
B, 12	6 cm, H, X, FIR	0.012	0.109	>0.400
B, 12	6 cm, H, X, FIR, D	0.007	0.069	>0.400
X, FIR	6 cm, H, B, 12	0.032	0.296	0.384
X, FIR	6 cm, H, B, 12, D	−0.021	−0.197	>0.400
X , 12	6 cm, H, B, FIR	0.014	0.130	>0.400
X , 12	6 cm, H, B, FIR, D	0.060	0.563	0.289
FIR, 12	6 cm, H, B, X	0.615	7.315	<0.005
FIR, 12	6 cm, H, B, X, D	0.632	7.602	<0.005

lists the test pair, the parameters held fixed in the test, the partial rank coefficient, the test statistic T (not to be confused with the earlier defined morphological type), and the corresponding probability of chance correlation, for the total sample and each of the three morphological subsamples. The number of points used in each sample is also given (N). Note that the results for the early subsample can only be considered indicative, given the small number of points. These conclusions are supported by the analysis of Paper II, which uses the larger samples available for more limited groupings of variables.

Figure 10 shows in a diagrammatic form the results of the partial rank analysis for the total, early, intermediate, and late samples. Only the strongest links ($P < 2\%$) are plotted, with their relative strength indicated by the number of lines connecting variables. Two correlations remain very significant, no matter what combination of other variables we held fixed: L_B-L_H and $L_{\rm FIR}$-L_{12}. L_B-L_H links stellar emission processes (Aaronson et al. 1979), and while the presence of a strong fundamental correlation is not surprising, it also points to a basic connection between the initial mass function (IMF) of low-mass stars and that of intermediate- to high-mass stars (Trinchieri et al. 1989). The tight 12 μm–FIR correlation is consistent with previous findings pointing to evidence of similarity in the grain size spectrum and distribution in the dense ISM of all spirals (see Helou, Ryter, & Soifer 1991; Knapp, Gunn, & Wynn-Williams 1992 and references therein). In this picture the 12 μm emission would be due to small-size grains heated to nonequilibrium temperature for short times by the same UV photon field responsible for the FIR emission.

We find morphology-related differences in the correlations. In the early sample there is an additional strong link of $L_{6\,{\rm cm}}$ with L_{12}. The intermediate sample results look similar, although the L_B-L_H link is by far the strongest. The results change in the late sample: the L_B-L_H link persists, but otherwise we are in the presence of strong connections of both 12 μm and radio continuum with the FIR, again suggesting the dominant effect of star formation processes in these galaxies (Paper II). Inspection of Appendix C shows that most combinations of variables also yield a significant X-ray–FIR link in Sc–Irr galaxies, associating the X-ray emission with the star-forming population and associated processes. This point will be investigated further in Paper II.

In Table 8, to examine possible distance effects, we include two lines for each luminosity pair. The first line contains the luminosity-luminosity correlation results including the distance as a variable that is held fixed, while the second line excludes the distance entirely as a variable. To explore this point further, we performed the partial Spearman rank test on each pair of variables (holding only the distance fixed), by using the same sample sizes used in the bivariate analysis. The results (not shown) compare well with those of Table 4.

While we have X-ray and B data for all of the galaxies and far-IR data for 93% of the sample, our coverage is much sparser in the H and 6 cm bands. The regression analysis of each luminosity pair was performed for galaxy samples with data in both of the variables in the luminosity pair, regardless of coverage in the other four variables, for the purpose of using the largest sample possible for each pair. Instead, for the multivariate Spearman partial rank analysis, which requires data for each galaxy in all six of the variables under consideration, the sample becomes reduced to those galaxies observed in all of the parameters: X-ray, B, H, 12 μm, FIR, and 6 cm, numbering 94 galaxies. To explore the effects of the two different sample selections, we performed a partial rank analysis on subsamples of variables, by using the largest number of objects possible in each case. After checking against the results for the sample of 94 galaxies (six variables), we find that our conclusions are generally not affected: while some correlations are more significant in the larger samples, the relative strengths of the different correlations (which is what we want to establish with the multivariate analysis) follow similar patterns.

8. SUMMARY AND CONCLUSIONS

We have performed bivariate and multivariate survival analyses, which take into account censoring (limits), on a sample of 234 galaxies, covering morphological types from S0/a to Irr. These galaxies were all observed in X-rays with the *Einstein Observatory* (FKT92), and their X-ray emission is not likely to be dominated by an AGN, although some of them may harbor a faint active nucleus (i.e., they are representative of normal galaxies in X-rays). Besides the X-ray emission, included in the analysis were optical (B), near-IR (H), mid- and far-IR, and radio continuum emissions. Their morphological type was considered explicitly in the analysis by dividing the sample into "early" (S0/a–Sab, bulge-dominated), "intermediate" (Sb–Sbc), and "late" (Sc–Irr) subsamples.

In this paper we have described the sample and the derivation of the variables used in the analysis, reported in detail the results of the statistical analysis, and discussed possible biases, to conclude that our overall results are not likely to be affected in any major way, by either distance bias, incomplete data coverage, or beam size effects.

We find that most pairs of luminosities are correlated when considered individually. A regression analysis demonstrates that different correlations follow different power-law relations. Some of these power laws are morphology dependent. These effects and their significance are discussed further in Paper II.

When we ask which of these correlations are likely to be fundamental and which instead may arise from secondary effects, we find that only two are consistently very strong, regardless of galaxy morphology. These are the L_B-L_H and the L_{12}-$L_{\rm FIR}$ correlations. The former links stellar emission processes (Aaronson et al. 1979) and points to a basic connection between the IMF of low-mass stars and that of intermediate- to high-mass stars (e.g., Trinchieri et al. 1989). The latter may be related to the heating of small and larger size dust grains by the same UV photon field (e.g., Helou et al. 1991).

Other highly significant "fundamental" correlations exist but are morphology dependent. In particular, in S0/a–Sab (and also, but possibly less strikingly, in Sb–Sbc) galaxies we observe a strong link of radio continuum and 12 μm (not FIR) emission, while in Sc–Irr, the strong link is with FIR (not 12 μm) emission. These differences we will explore further in Paper II.

We also find that in the late sample (Sc–Irr) there is an indication of an overall connection of X-ray, mid- and far-IR, and radio continuum emission, which could be related to the presence of star-forming activity in these galaxies (see also Paper II).

We thank Louis Ho, Jonathan McDowell, and Kim McLeod for their useful input and interest in this work, which was part of the Harvard undergraduate senior thesis of A. Shapley. We thank John Huchra for discussions on galaxy distances. We used the NASA Extragalactic Database (NED) to gather some of the data used in this paper. The ADS abstract service was of help in our literature search. This work was supported by NASA grant NAGW-2681 (LTSA) and by NASA contract NAS 8-39073 (Chandra X-Ray Center).

APPENDIX A

DISTANCES

For this paper we have revised the distances used in the FKT92 catalog. The motivation was that recent accurate direct measurements from local indicators exist for nearby galaxies, which make up a large fraction of the sample. We have performed a thorough literature search through 1999 November to determine the most reliable, up-to-date distances for our sample. If a recent and reliable distance estimate was not found, we adopted H_0 distances for $H_0 = 75$ km s^{-1} Mpc^{-1}, derived from the YTS77 corrected velocity. Heliocentric velocities (V_0) were taken from NED. For each galaxy, Table 9 lists the adopted modulus and distance, followed by the heliocentric velocity, the YTS77 corrected velocity, and H_0 distances for $H_0 = 75$ km s^{-1} Mpc^{-1}. For many galaxies a modulus and distance are not listed in the second and third columns. This is because there are no modern distance estimates available in the literature. In those cases in which we give no H_0 distance, the actual measured distance is solid enough that there is no defensible reason for not using it.

To estimate the uncertainties that may arise from applying different corrections to the heliocentric velocities, we also estimated velocities relative to the CMB frame, using a code provided by J. Huchra (1999, private communication). The plot of the fractional difference between YTS77 and CMB velocities (Fig. 11) for galaxies with Hubble flow distances shows that differences are within 20% for $V > 1500$ km s^{-1} and within 30% down to 1000 km s^{-1}. Seven more nearby galaxies have differences between 40% and 60%. In § 5 we discuss how these uncertainties do not produce significant differences in the results of our correlation analysis.

In the following subsections we give detailed notes and references.

TABLE 9

DISTANCES

Galaxy	Dist. Mod. from Lit.	Distance (Mpc)	V_0 (km s^{-1})	V_{YTS77} (km s^{-1})	$D(H_0 = 75)$ (Mpc)
NGC 0125......	...	...	5306	5491.2	73.2
NGC 0224......	24.44	0.77	−300	−13.2	...
NGC 0247......	27.40	3.0	159	228.7	...
NGC 0253......	27.45	3.1	251	297.8	...
SMC	18.90	0.060	175	−8.6	...
NGC 0309......	...	...	5662	5780.4	77.1
I1613	24.42	0.76	−230	−62.0	...
NGC 0449......	...	...	4824	5085.5	67.8
NGC 0520......	32.88	37.8	2217	2382.3	...
NGC 0521......	...	...	5040	5196.8	69.3
NGC 0523......	...	...	4750	5009.6	66.8
NGC 0524......	...	...	2421	2608.6	34.8
NGC 0578......	...	...	1630	1671.6	22.3
NGC 0598......	24.63	0.84	−179	69.3	...
NGC 0625......	28.46	4.9	386	333.2	...
NGC 0628......	29.32	7.3	656	859.8	...
I1727	...	...	338	571.3	7.6
NGC 0672......	29.50	7.9	421	654.4	...
NGC 0772......	32.58	32.8	2458	2660.1	...
NGC 0871......	...	...	3736	3912.1	52.2
NGC 0877......	...	...	3913	4088.6	54.5
NGC 0936......	...	...	1340	1447.1	19.3
NGC 0941......	...	...	1608	1714.6	22.9
NGC 0945......	...	...	4484	4549.1	60.7
NGC 0985......	...	...	12929	12997.9	173.3
NGC 1042......	...	...	1373	1439.6	19.2
NGC 1068......	...	...	1137	1238.7	16.5
NGC 1073......	...	...	1211	1317.8	17.6
NGC 1087......	...	...	1519	1616.0	21.5
NGC 1090......	...	...	2758	2855.9	38.1
NGC 1097......	...	...	1275	1238.2	16.5
NGC 1218......	...	...	8644	8744.3	116.6
NGC 1300......	...	...	1568	1557.6	20.8
NGC 1313......	28.27	4.5	457	264.4	...
NGC 1317......	31.32	18.4	1941	1852.1	...
NGC 1350......	31.32	18.4	1890	1810.2	...
NGC 1358......	...	...	4013	4055.0	54.1
NGC 1365......	31.32	18.4	1662	1570.3	...
NGC 1380......	31.00	15.8	1841	1752.2	...
NGC 1386......	31.32	18.4	864	770.9	...
NGC 1398......	...	...	1407	1352.7	18.0
NGC 1421......	...	...	2090	2088.6	27.8
I0342	27.78	3.6	34	279.3	...
NGC 1512......	...	...	901	763.1	10.2
NGC 1533......	...	...	1342	1159.7	15.5
NGC 1559......	31.02	16.0	1292	1089.0	...
NGC 1566......	...	...	1342	1159.7	15.5
NGC 1569......	26.15	1.7	−89	138.4	...
NGC 1614......	...	...	4778	4756.6	63.4
NGC 1625......	...	...	4700	4698.4	62.6
NGC 1672......	...	...	1350	1143.9	15.3
NGC 1784......	...	...	2316	2255.2	30.1
LMC	18.50	0.050	324	87.1	...
NGC 1961......	34.39	75.4	3930	4142.9	...
U3691	...	...	2203	2164.0	28.9
NGC 2276......	31.16	17.1	2417	2650.4	...
NGC 2366......	27.68	3.4	100	284.5	...
NGC 2403......	27.51	3.2	131	300.5	...
NGC 2441......	33.76	56.5	3470	3663.1	...
NGC 2525......	...	...	1581	1393.5	18.6
NGC 2608......	...	...	2135	2112.6	28.2
NGC 2642......	...	...	4342	4165.2	55.5
NGC 2683......	...	...	410	406.2	5.4
NGC 2763......	...	...	1893	1663.9	22.2
NGC 2773......	...	...	5406	5266.2	70.2

TABLE 9—*Continued*

Galaxy	Dist. Mod. from Lit.	Distance (Mpc)	V_0 (km s^{-1})	V_{YTS77} (km s^{-1})	$D(H_0 = 75)$ (Mpc)
NGC 2775	...	...	1421	1280.4	17.1
NGC 2777	...	...	1421	1280.4	17.1
NGC 2782	...	...	2562	2586.2	34.5
NGC 2835	...	...	888	634.4	8.5
NGC 2841	31.98	24.9	638	716.1	...
NGC 2848	...	...	2044	1807.1	24.1
NGC 2903	...	...	556	478.8	6.4
NGC 2914	...	...	3151	3017.2	40.2
NGC 2992	...	...	2367	2130.4	28.4
NGC 2993	...	...	2367	2130.4	28.4
NGC 3031	27.80	3.6	−34	127.0	...
NGC 3034	27.80	3.6	203	366.7	...
NGC 3067	...	...	1476	1449.9	19.3
NGC 3066	...	...	2049	2223.2	29.6
NGC 3077	27.80	3.6	14	173.0	...
NGC 3079	31.44	19.4	1125	1221.0	...
NGC 3081	...	...	2367	2102.1	28.0
NGC 3125	...	...	1080	797.3	10.6
NGC 3166	29.72	8.8	1345	1172.4	...
NGC 3169	29.72	8.8	1233	1060.5	...
NGC 3175	...	...	1111	829.4	11.1
NGC 3184	29.30	7.2	593	612.7	...
NGC 3227	...	...	1157	1062.1	14.2
I2574	27.80	3.6	47	203.3	...
NGC 3281	...	...	3439	3144.8	41.9
NGC 3310	...	...	980	1062.4	14.2
NGC 3346	...	...	1260	1138.7	15.2
NGC 3351	30.01	10.1	778	641.2	...
NGC 3353	...	...	944	1038.9	13.9
NGC 3368	30.27	11.3	897	760.7	...
NGC 3389	32.38	29.9	1301	1168.1	...
NGC 3395	...	...	1620	1592.8	21.2
NGC 3430	...	...	1585	1557.6	20.8
NGC 3445	...	...	2023	2123.1	28.3
NGC 3448	...	...	1350	1436.4	19.2
NGC 3455	...	...	1107	997.7	13.3
NGC 3489	30.32	11.6	708	581.9	...
NGC 3504	...	...	1539	1485.2	19.8
NGC 3512	...	...	1376	1322.6	17.6
NGC 3593	...	...	628	497.4	6.6
NGC 3628	30.37	11.9	847	720.7	...
NGC 3660	...	...	3678	3455.2	46.1
NGC 3690	...	...	3132	3241.4	43.2
NGC 3718	...	...	994	1075.7	14.3
NGC 3729	30.95	15.5	1024	1106.1	...
NGC 3783	...	...	2926	2630.1	35.1
NGC 3884	...	...	6948	6859.4	91.5
NGC 3887	...	...	1209	961.8	12.8
NGC 3888	...	...	2408	2506.0	33.4
NGC 3893	30.95	15.5	973	1033.9	...
NGC 3896	30.95	15.5	869	929.7	...
NGC 3991	...	...	3192	3167.8	42.1
NGC 3994	...	...	3096	3071.5	42.1
NGC 3995	...	...	3254	3229.6	42.1
I0749	30.95	15.5	784	815.0	...
I0750	30.95	15.5	703	734.0	...
NGC 4036	...	...	1397	1525.8	20.3
NGC 4038	31.83	23.3	1624	1373.8	...
NGC 4041	...	...	1234	1364.0	18.2
NGC 4051	30.95	15.5	725	766.3	...
NGC 4151	...	...	995	1010.8	13.5
NGC 4156	...	...	6750	6766.2	90.2
NGC 4178	30.51	12.6	378	248.5	...
NGC 4190	27.75	3.5	230	232.0	...
NGC 4192	30.80	14.5	−142	−251.7	...
NGC 4206	31.48	19.7	702	583.6	...

TABLE 9—*Continued*

Galaxy	Dist. Mod. from Lit.	Distance (Mpc)	V_0 (km s^{-1})	V_{YTS77} (km s^{-1})	$D(H_0 = 75)$ (Mpc)
NGC 4212......	31.36	18.7	−81	−195.0	...
NGC 4214......	28.06	4.1	291	291.8	...
NGC 4216......	31.13	16.8	131	13.4	...
NGC 4224......	33.30	45.7	2603	2458.7	...
NGC 4235......	31.48	19.8	2410	2264.6	...
NGC 4236......	27.80	3.6	−5	160.3	...
NGC 4244......	28.28	4.5	243	252.0	...
NGC 4245......	...	...	890	856.1	11.4
NGC 4246......	32.83	36.8	3725	3579.9	...
NGC 4254......	30.56	12.9	2407	2296.4	...
NGC 4258......	29.29	7.2	448	506.8	...
NGC 4260......	33.14	42.4	1958	1808.3	...
NGC 4298......	31.03	16.1	1141	1032.1	...
NGC 4303......	30.12	10.6	1569	1412.8	...
NGC 4321......	31.04	16.1	1586	1483.5	...
NGC 4351......	30.16	12.9	2310	2190.3	...
NGC 4378......	33.45	49.1	2551	2397.9	...
NGC 4385......	...	...	2140	1968.0	26.2
NGC 4388......	31.11	16.7	2517	2400.0	...
NGC 4394......	31.93	24.3	922	832.3	...
NGC 4424......	28.00	4.0	439	307.1	...
NGC 4429......	30.57	13.0	1137	1013.2	...
NGC 4438......	30.45	12.3	69	−45.6	...
NGC 4449......	27.33	2.9	201	245.3	...
NGC 4450......	30.77	14.2	1956	1861.5	...
NGC 4461......	30.40	12.0	1918	1804.6	...
NGC 4464......	31.32	18.4	1255	1118.0	...
NGC 4477......	31.08	16.4	1353	1242.1	...
NGC 4501......	31.20	17.4	2280	2173.6	...
NGC 4503......	30.35	11.7	1364	1242.1	...
NGC 4522......	31.06	16.3	2324	2193.2	...
NGC 4527......	30.68	13.7	1734	1573.9	...
NGC 4535......	30.47	12.4	1957	1821.9	...
NGC 4536......	31.10	16.6	1804	1641.9	...
I3528	...	...	13764	13664.2	182.2
NGC 4548......	30.81	14.5	486	381.2	...
NGC 4565......	30.13	10.6	1227	1179.9	...
NGC 4567......	31.74	22.3	2268	2148.0	...
NGC 4569......	29.77	9.0	−235	−345.8	...
NGC 4571......	30.87	14.9	342	236.3	...
NGC 4579......	31.51	20.0	1519	1402.1	...
NGC 4594......	29.86	9.4	1091	876.1	...
NGC 4603......	...	...	2562	2275.1	30.3
NGC 4631......	27.69	3.5	606	594.5	...
NGC 4639......	32.00	25.1	1010	901.9	...
NGC 4643......	31.02	16.0	1399	1239.3	...
NGC 4647......	31.48	19.8	1415	1299.1	...
NGC 4651......	31.57	20.7	805	712.4	...
NGC 4654......	30.56	13.0	1035	926.6	...
NGC 4665......	31.02	16.0	785	630.7	...
NGC 4689......	30.75	14.1	1619	1515.2	...
NGC 4698......	32.80	36.3	999	870.5	...
NGC 4736......	28.85	5.9	310	345.4	...
NGC 4826......	...	...	408	346.6	4.6
NGC 4845......	32.42	30.5	1232	1076.6	...
NGC 4861......	...	...	846	852.2	11.4
I4182	28.36	4.7	321	343.5	...
NGC 5033......	...	...	878	898.3	12.0
NGC 5037......	31.52	20.2	1904	1686.7	...
NGC 5068......	...	...	672	442.5	5.9
NGC 5079......	...	...	2870	2668.3	35.6
NGC 5088......	...	...	1434	1233.1	16.4
NGC 5101......	...	...	1861	1615.1	21.5
NGC 5135......	...	...	4112	3861.9	51.5
NGC 5194......	29.62	8.4	463	541.5	...
NGC 5204......	29.28	7.2	204	334.0	...

TABLE 9—*Continued*

Galaxy	Dist. Mod. from Lit.	Distance (Mpc)	V_0 (km s^{-1})	V_{YTS77} (km s^{-1})	$D(H_0 = 75)$ (Mpc)
NGC 5236......	28.27	4.5	516	271.1	...
NGC 5248......	...	...	1153	1049.6	14.0
NGC 5253......	28.10	4.2	404	156.2	...
I4329A	...	...	4793	4553.0	60.7
NGC 5313......	...	...	2538	2590.1	34.5
NGC 5326......	...	...	2501	2551.6	34.0
NGC 5350......	...	...	2304	2359.5	31.5
NGC 5364......	...	...	1241	1130.8	15.1
NGC 5410......	...	...	3738	3799.8	50.7
NGC 5457......	29.28	7.2	241	363.9	...
NGC 5474......	29.28	7.2	277	397.7	...
NGC 5477......	29.28	7.2	304	428.3	...
NGC 5506......	...	...	1815	1680.1	22.4
NGC 5548......	...	...	5149	5145.0	68.6
NGC 5566......	...	...	1507	1407.1	18.8
NGC 5585......	29.28	7.2	305	443.8	...
NGC 5643......	...	...	1199	951.8	12.7
NGC 5645......	...	...	1367	1288.6	17.2
NGC 5674......	...	...	7472	7387.8	98.5
NGC 5683......	...	...	10732	10843.6	144.6
NGC 5689......	...	...	2160	2272.2	30.3
NGC 5728......	...	...	2788	2618.6	34.9
NGC 5850......	...	...	2556	2478.6	33.0
NGC 5879......	...	...	772	931.0	12.4
NGC 5907......	30.36	11.8	667	826.2	...
NGC 5985......	...	...	2520	2698.8	36.0
NGC 6052......	...	...	4716	4765.1	63.5
NGC 6300......	...	...	1110	903.3	12.0
NGC 6454......	...	...	9169	9394.2	125.3
NGC 6503......	28.58	5.2	44	288.5	...
NGC 6744......	...	...	841	670.3	8.9
NGC 6814......	...	...	1563	1646.2	21.9
NGC 6822......	23.50	0.50	−56	7.8	...
NGC 6872......	...	...	4818	4637.5	61.8
NGC 6890......	...	...	2471	2405.5	32.1
NGC 6946......	28.71	5.5	52	340.9	...
NGC 6951......	...	...	1426	1712.2	22.8
NGC 6962......	...	...	4211	4375.0	58.3
I5063	...	...	3380	3265.6	43.5
NGC 7213......	...	...	1792	1740.9	23.2
NGC 7314......	...	...	1422	1485.7	19.8
NGC 7320......	30.89	15.1	776	1069.0	...
NGC 7331......	30.89	15.1	821	1114.8	...
NGC 7339......	31.15	17.0	1346	1617.6	...
NGC 7469......	32.35	29.5	4916	5141.1	...
I5283	32.35	29.5	4894	5119.2	...
NGC 7496......	...	...	1612	1582.7	21.1
NGC 7552......	...	...	1612	1582.7	21.1
NGC 7582......	...	...	1612	1582.7	21.1
NGC 7590......	...	...	1612	1582.7	21.1
NGC 7599......	...	...	1612	1582.7	21.1
NGC 7611......	...	...	3330	3551.0	47.3
NGC 7673......	...	...	3401	3670.3	48.9
NGC 7677......	...	...	3539	3808.1	50.8
NGC 7679......	...	...	5138	5340.2	71.2
NGC 7682......	...	...	5120	5322.3	71.0
NGC 7714......	...	...	2799	2994.6	39.9
NGC 7769......	...	...	4214	4470.3	59.6
NGC 7771......	...	...	4287	4543.1	60.6
NGC 7793......	28.03	4.0	230	252.8	...

NOTE.—Table 9 is also available in machine-readable form in the electronic edition of the *Astrophysical Journal Supplement*.

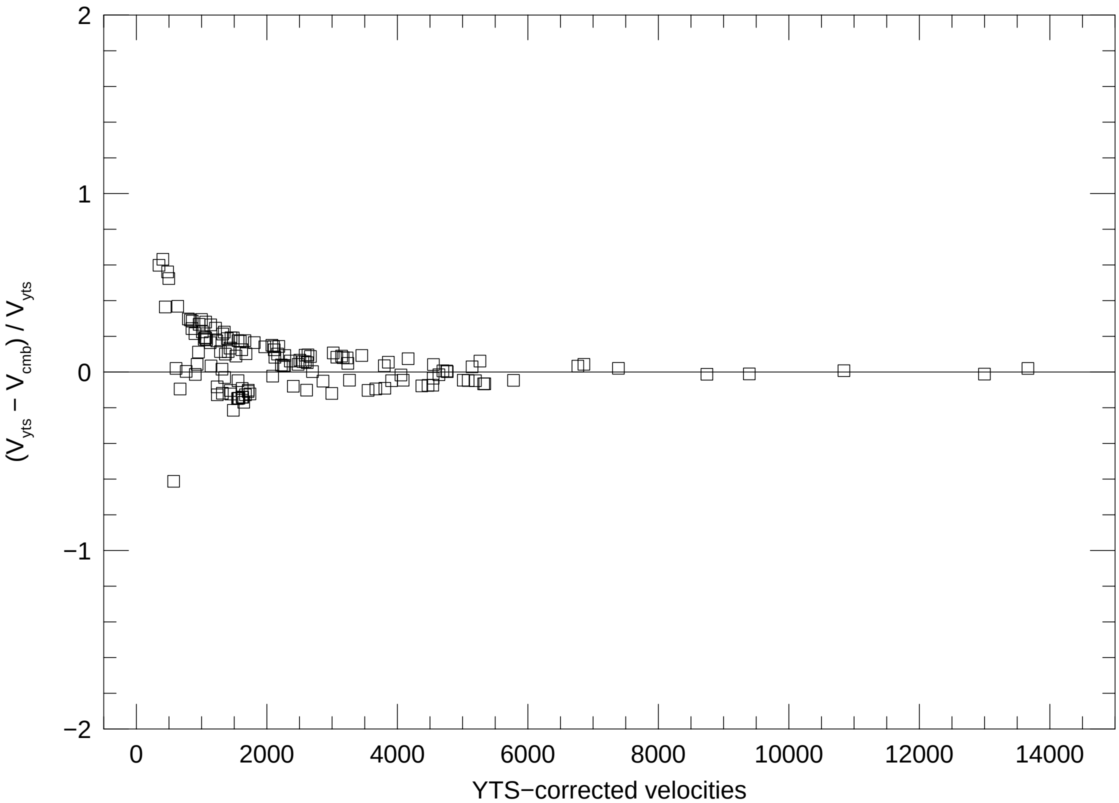

FIG. 11.—Fractional difference between YTS77 and CMB corrected Hubble flow velocities vs. the YTS77 velocity

A1. NOTES ON GROUPS

The Local Group.—We adopt a distance modulus of 18.50 for the LMC (Madore & Freedman 1998). While there are competing, generally shorter, distance moduli for the LMC in the recent literature (e.g., Luri et al. 1998), the range of values under discussion is small: a systematic uncertainty of $\sim$0.2 mag in the zero point of the distance modulus will not effect the results of this study. A distance modulus of 18.50 gives a physical distance of 50 kpc. The SMC has a distance modulus greater than that of the LMC by $\sim$0.4 mag. Although studies differ on the zero point of the distance scale, nearly all of them are consistent with this difference in the distances to the two Clouds (e.g., Böhm-Vitense 1997). We thus adopt an SMC distance modulus of 18.90, corresponding to a distance of 60 kpc. For our other Local Group objects, we adopt Cepheid distances tied to the adopted modulus for the LMC. For NGC 224 (M31), IC 1613, and NGC 598 (M33) we adopt the result of Freedman & Madore (1991). For NGC 6822 we adopt the result of Gallart, Aparicio, & Vílchez (1996).

The Sculptor Group.—We adopt the Cepheid distance to NGC 300 from Freedman et al. (1992). We note that there is evidence of a substantial distance spread among Sculptor Group members (Puche & Carignan 1988). We thus adopt the relative distances from Puche & Carignan (1988) between NGC 300 and our sample: $\Delta(m - M) = 0.74$ for NGC 247, $\Delta(m - M) = 0.79$ for NGC 253, and $\Delta(m - M) = 1.37$ for NGC 7793. Côté et al. (1997) argue that NGC 625 is a Sculptor Group member, lying between the main concentration and NGC 45. We adopt a distance of 4.9 Mpc based on the relative velocities and distances of NGC 7793, NGC 45, and NGC 625.

The IC 342/Maffei 1 Group.—Krismer, Tully, & Gioia (1995) derive Tully-Fisher distances to NGC 1560 and UGCA 105. The mean of these measures gives a group distance of 3.6 Mpc. The best distance estimate for NGC 1569 is that of Karachentsev et al. (1997), who derive a distance of 1.7 Mpc from bright stars. Krismer et al. (1995) find that NGC 1569 does not yield a plausible Tully-Fisher distance.

NGC 1533 and NGC 1566 (*the Dorado Group*).—The mean velocity of 11 group members tabulated in Ferguson & Sandage (1990) is 1342 km s^{-1}. We adopt this for both galaxies and compute an H_0 distance.

NGC 2775 and NGC 2777.—We use an H_0 distance, based on the mean velocity of the two group members.

NGC 2992 and NGC 2993.—We use an H_0 distance, based on the mean velocity of the two group members.

The M81 Group.—We adopt the Freedman et al. (1994) Cepheid distance to M81 and use this distance for NGC 3034, NGC 3077, IC 2574, and NGC 4236. For NGC 2366, we adopt the Cepheid distance from Tolstoy et al. (1995). For NGC 2403, we adopt the Cepheid distance from Freedman & Madore (1988).

The Leo I Group.—We adopt the Cepheid distance to M96 (NGC 3368) and NGC 3489 from Kennicut et al. (1998).

The CVn I cloud.—We adopt recent bright star distances for the following members of our sample: NGC 4190 from Tikhonov & Karachentsev (1998); NGC 4214 from Makarova, Karachentsev, & Georgiev (1997); and NGC 4244 from Karachentsev & Drozdovksy (1998).

The M101 Group.—Stetson et al. (1998) state, "An unweighted average of the two (Cepheid-based) moduli is 29.28 $\pm$ 0.14 mag (with the uncertainty of the LMC modulus having been subtracted from the uncertainty each of the two estimates and added back in to the uncertainty of the average), implying a distance of 7.2 $\pm$ 0.5 Mpc." This is for M101 (NGC 5457). We adopt this result for NGC 5204, NGC 5474, NGC 5477, and NGC 5585 also.

The Cen A Group.—Saha et al. (1995) derive a Cepheid distance for NGC 5253. For NGC 5236 (M83) Eastman, Schmidt, & Kirshner (1996) derive a Type II supernova (SN II) expanding photosphere distance.

The NGC 3166 Group.—Garcia et al. (1996) derive a group-average Tully-Fisher distance of 8.8 Mpc. We adopt this for both NGC 3166 and NGC 3169.

The Ursa Minor Cluster.—Pierce & Tully (1988) derive a mean Tully-Fisher distance of 15.5 Mpc for the Ursa Minor Cluster. We adopt this distance for NGC 3729, NGC 3893, NGC 3896, NGC 4051, IC 749, and IC 750.

The Fornax Cluster.—Shanks (1997) quotes a Cepheid distance for NGC 1365 of 18.4 Mpc. We adopt this distance for NGC 1317, NGC 1350, and NGC 1386 as well. For NGC 1380, we adopt the surface brightness fluctuation (SBF) distance reported by Hamuy et al. (1996).

The Virgo Cluster.—Given the evidence for substantial depth to the Virgo Cluster (e.g., Yasuda, Fukugita, & Okamura 1997), we adopt individual distance estimates to Virgo members as follows. For NGC 4321 (M100) we adopt the Cepheid distance from Freedman et al. (1994). For NGC 4536 we adopt the Cepheid distance from Saha et al. (1996). For NGC 4571 we adopt the bright star distance of Pierce, McClure, & Racine (1992). For NGC 4579 we adopt the SN II expanding photosphere distance from Eastman et al. (1996). For NGC 4639 we adopt the Cepheid distance from Sandage et al. (1996). Schöniger & Sofue (1997) derive distances for NGC 4303, NGC 4438, and NGC 4647, based on combined CO and H I Tully-Fisher. For NGC 4429 we adopt the fundamental plane distance of Gavazzi et al. (1999). For NGC 4527 we adopt the SN Ia distance from Shanks (1997). Teerikorpi et al. (1992) give Tully-Fisher distances for NGC 4567 and NGC 4845. Yasuda et al. (1997) give *B*-band Tully-Fisher distances for a large sample of Virgo galaxies. The Yasuda et al. (1997) distances match the available Cepheid distances within the errors. We adopt the Yasuda et al. (1997) distances for the following galaxies: NGC 4178, NGC 4192, NGC 4206, NGC 4212, NGC 4216, NGC 4235, NGC 4254, NGC 4298, NGC 4351, NGC 4388, NGC 4394, NGC 4424, NGC 4450, NGC 4501, NGC 4522, NGC 4535, NGC 4548, NGC 4569, NGC 4651, NGC 4654, NGC 4689, and NGC 4698. We adopt the Yasuda et al. (1997) mean Virgo distance of 16.0 Mpc for NGC 4643 and NGC 4665. We adopt the Gavazzi et al. (1999) distances for NGC 4461, NGC 4464, NGC 4477, and NGC 4503.

Systems behind the Virgo Cluster.—Yasuda et al. (1997) also report Tully-Fisher distances for the following galaxies in the background of the Virgo Cluster: NGC 4224, NGC 4246, NGC 4260, and NGC 4378.

The Grus Group.—We adopt a mean H_0 distance for the group members (NGC 7496, NGC 7552, NGC 7582, NGC 7590, and NGC 7599).

A2. NOTES ON INDIVIDUAL GALAXIES

NGC 628 (M74).—Sharina, Karachentsev, & Tikhonov (1996) derive a distance based on bright stars. They find similar distances for several of M74's dwarf companions. Their result is roughly between the very discrepant results from older studies. The distance is confirmed by Sohn & Davidge (1996).

NGC 672.—We adopt the result of Sohn & Davidge (1996), who derive a distance for NGC 672 based on bright stars.

NGC 1313.—Ryder et al. (1995) cite a mean distance of 4.5 Mpc based on tertiary distance estimators. They further state that there is no discrepancy between the long- and short-scale distance camps in the cited work.

NGC 1559.—We adopt the SN II expanding photosphere distance from Eastman et al. (1996).

NGC 2441.—We adopt the SN Ia distance from Riess, Press, & Kirshner (1996).

NGC 3351.—Graham et al. (1997) quote a Cepheid-based distance modulus of 30.01 $\pm$ 0.19, corresponding to a distance of 10.05 $\pm$ 0.88 Mpc.

NGC 3368.—Kennicutt et al. (1998) quote a Cepheid-based distance modulus of 30.27 $\pm$ 0.13, corresponding to a distance of 11.3 Mpc.

NGC 3628.—There are no direct distance estimates. NGC 3628 is a member of the NGC 3627 Group (Garcia 1993). Theureau et al. (1997) quote a Cepheid-based distance to NGC 3627, and we adopt this distance for NGC 3628.

NGC 4258 (M106).—Herrnstein et al. (1999) derive a geometric distance of 7.2 Mpc for a distance modulus of $(m - M)_0 =$ 29.29.

NGC 4449.—We adopt the bright star distance from Karachentsev & Drozdovsky (1998).

NGC 4565.—We adopt the result of Forbes (1996), which is based on an average of the results from the globular cluster luminosity function, SBF, and the planetary nebula luminosity function (PNLF).

NGC 4594 (M104).—We adopt the SBF distance from Ajhar et al. (1997).

IC 4182.—We adopt the Cepheid distance from Saha et al. (1994).

NGC 5037.—There are no direct distance estimates. However, Ferguson & Sandage (1990) list NGC 5037 as a member of the NGC 5044 Group. Further, de Vaucouleurs & Olson (1984) give Faber-Jackson distances for two group members (NGC 5017 and NGC 5044). Tutui & Sofue (1997) give a distance for NGC 5054 based on the average of H I and CO Tully-Fisher. We adopt the mean of these distances for NGC 5037.

NGC 5194 (M51).—We adopt the PNLF distance from Feldmeier, Ciardullo, & Jacoby (1997).

NGC 6503.—We adopt the bright star distance from Karachentsev & Sharina (1997).

NGC 6946.—Pierce (1994) gives a Tully-Fisher distance of 5.5 Mpc. Schmidt et al. (1994) give an SN II expanding photosphere distance of 5.7 Mpc. Schöniger & Sofue (1994) give a CO Tully-Fisher distance of 5.4 Mpc. We adopt 5.5 Mpc.

NGC 7331.—We adopt the Cepheid distance from Hughes et al. (1998).

Tutui & Sofue (1997) derive distances based on the average of CO and H I Tully-Fisher that we adopt for the following members of our sample: NGC 520, NGC 772, NGC 1961, and NGC 4038.

Schöniger & Sofue (1994) derive distances from the average of H I and CO Tully-Fisher that we adopt for the following members of our sample: NGC 2276, NGC 3079, NGC 4631, NGC 4736, NGC 5907, and NGC 7469. IC 5283 is a companion of NGC 7469, and we adopt the same distance as NGC 7469.

We adopt distances quoted by Shanks (1997), based on Cepheids or SNe Ia, for the following members of our sample: NGC 2841, NGC 3351, and NGC 3389. The distance to NGC 3351 is confirmed by Graham et al. (1997).

We adopt SN Ia and SN II distances from Pierce (1994) for the following members of our sample: NGC 3184 and NGC 7339.

APPENDIX B

CALCULATION OF THE REGRESSION BISECTORS

The bisector slope ($\beta_{\rm bis}$) and intercept ($\alpha_{\rm bis}$) were estimated using the following expressions from Isobe et al. (1990):

$$\beta_{\rm bis} = (\beta_1 + \beta_2)^{-1}[\beta_1 \beta_2 - 1 + \sqrt{(1 + \beta_1^2)(1 + \beta_2^2)}] , \quad \text{(B1)}$$

$$\alpha_{\rm bis} = y_{\rm int} - \beta_{\rm bis} x_{\rm int} , \quad \text{(B2)}$$

where $y_{\rm int}$ and $x_{\rm int}$ are the coordinates of the intersection point of two regressions, $y = \beta_1 x + \alpha_1$ and $y = \beta_2 x + \alpha_2$.

The bisector slope $\beta_{\rm bis}$ is a function of two interdependent variables, β_1 and β_2. Therefore, in order to find the uncertainty in $\beta_{\rm bis}$, we need to calculate the following (from Isobe et al. 1990):

$$\sigma^2_{\beta_{\rm bis}} = \sigma^2_{\beta_1}\left(\frac{\partial \beta_{\rm bis}}{\partial \beta_1}\right)^2 + \sigma^2_{\beta_2}\left(\frac{\partial \beta_{\rm bis}}{\partial \beta_2}\right)^2 + 2\sigma_{\beta_1 \beta_2}\left(\frac{\partial \beta_{\rm bis}}{\partial \beta_1}\right)\left(\frac{\partial \beta_{\rm bis}}{\partial \beta_2}\right) , \quad \text{(B3)}$$

where σ_{β_1} and σ_{β_2} are the uncertainties on the slopes β_1 and β_2, respectively; $\partial\beta_{\rm bis}/\partial\beta_1$ and $\partial\beta_{\rm bis}/\partial\beta_2$ are the respective partial derivatives of $\beta_{\rm bis}$ with respect to β_1 and β_2; and $\sigma_{\beta_1 \beta_2}$ is the covariance of β_1 and β_2.

We obtained σ_{β_1} and σ_{β_2} from the Schmitt's regression analysis package in ASURV, which provides a bootstrap error analysis. The expressions for the partial derivatives are

$$\frac{\partial \beta_{\rm bis}}{\partial \beta_1} = \frac{[1 + (\beta_2)^2]\beta_{\rm bis}}{(\beta_1 + \beta_2)\sqrt{(1 + \beta_1^2)(1 + \beta_2^2)}} , \quad \text{(B4)}$$

$$\frac{\partial \beta_{\rm bis}}{\partial \beta_2} = \frac{[1 + (\beta_1)^2]\beta_{\rm bis}}{(\beta_1 + \beta_2)\sqrt{(1 + \beta_1^2)(1 + \beta_2^2)}} . \quad \text{(B5)}$$

According to Isobe et al. (1990), $\sigma_{\beta_1 \beta_2}$, the covariance term, is calculated in the following manner:

$$\sigma_{\beta_1 \beta_2} = \frac{\beta_1}{[\sum_{i=1}^{n} (x_i - \bar{x})^2]^2} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})[(y_i - \bar{y}) - \beta_1(x_i - \bar{x})][(y_i - \bar{y}) - \beta_2(x_i - \bar{x})] , \quad \text{(B6)}$$

where $\bar{x}$ and $\bar{y}$ are the sample means and n is the number of data points.

Since the covariance depends explicitly on the coordinates of the data points in the sample, it is not obvious how to calculate it in the presence of censoring. We estimated the magnitude of the covariance term for all of the samples of data points, treating the upper limits as detections, in order to see if this term could be neglected in the calculation of the bisector slope uncertainty. We found that typically the covariance term is much smaller than the other two terms that are included in the expression for the bisector slope uncertainty. Thus, we decided to approximate the bisector slope uncertainty as

$$\sigma^2_{\beta_{\rm bis}} \approx \sigma^2_{\beta_1}\left(\frac{\partial \beta_{\rm bis}}{\partial \beta_1}\right)^2 + \sigma^2_{\beta_2}\left(\frac{\partial \beta_{\rm bis}}{\partial \beta_2}\right)^2 . \quad \text{(B7)}$$

The plots themselves (Fig. 4) offer a visual representation of the uncertainty of each bisector slope, which depends on the strength of the correlation between the two variables. The stronger the correlation, the smaller the angle between the two regressions, and the better defined the bisector slope.

APPENDIX C

RESULTS OF SPEARMAN PARTIAL RANK TESTS

Tables 10A, 10B, 10C, and 10D list the results of the partial rank analysis applied to each pair of variables for the total sample and the three subsamples.

TABLE 10A

SPEARMAN PARTIAL RANK ANALYSIS ON THE TOTAL SAMPLE ($N = 94$)

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
B, X	D	0.451	4.823	<0.005
	6 cm, D	0.338	3.413	<0.005
	H, D	0.172	1.658	0.053
	FIR, D	0.302	3.005	<0.005
	12, D	0.266	2.623	0.006
	6 cm, H, D	0.002	0.016	>0.400
	6 cm, FIR, D	0.323	3.225	<0.005
	6 cm, 12, D	0.286	2.814	<0.005
	H, FIR, D	−0.010	−0.096	>0.400
	H, 12, D	0.014	0.127	>0.400
	FIR, 12, D	0.264	2.581	0.007
	6 cm, H, FIR, D	−0.007	−0.065	>0.400
	6 cm, H, 12, D	−0.014	−0.133	>0.400
	6 cm, FIR, 12, D	0.294	2.881	<0.005
	H, FIR, 12, D	−0.011	−0.100	>0.400
H, X	D	0.436	4.621	<0.005
	6 cm, D	0.398	4.113	<0.005
	B, D	0.115	1.096	0.149
	FIR, D	0.362	3.681	<0.005
	12, D	0.316	3.155	<0.005
	6 cm, B, D	0.222	2.148	0.020
	6 cm, FIR, D	0.385	3.940	<0.005
	6 cm, 12, D	0.357	3.601	<0.005
	B, FIR, D	0.209	2.019	0.025
	B, 12, D	0.176	1.686	0.050
	FIR, 12, D	0.321	3.201	<0.005
	6 cm, B, FIR, D	0.221	2.130	0.020
	6 cm, B, 12, D	0.223	2.146	0.020
	6 cm, FIR, 12, D	0.356	3.570	<0.005
	B, FIR, 12, D	0.190	1.819	0.039
X, 12	D	0.459	4.932	<0.005
	6 cm, D	0.197	1.909	0.033
	H, D	0.350	3.550	<0.005
	B, D	0.282	2.791	<0.005
	FIR, D	0.216	2.100	0.022
	6 cm, H, D	0.059	0.557	0.291
	6 cm, B, D	0.057	0.535	0.298
	6 cm, FIR, D	0.169	1.622	0.058
	H, B, D	0.310	3.078	<0.005
	H, FIR, D	0.128	1.219	0.120
	B, FIR, D	0.155	1.483	0.076
	6 cm, H, B, D	0.061	0.569	0.287
	6 cm, H, FIR, D	0.060	0.566	0.288
	6 cm, B, FIR, D	0.093	0.880	0.202
	H, B, FIR, D	0.128	1.212	0.121
X, FIR	D	0.417	4.374	<0.005
	6 cm, D	0.109	1.038	0.163
	H, D	0.337	3.392	<0.005
	B, D	0.239	2.335	0.012
	12, D	0.042	0.400	0.346
	6 cm, H, D	0.021	0.197	>0.400
	6 cm, B, D	−0.027	−0.254	0.399
	6 cm, 12, D	−0.036	−0.344	0.366
	H, B, D	0.294	2.901	<0.005
	H, 12, D	0.076	0.722	0.240
	B, 12, D	0.017	0.157	>0.400
	6 cm, H, B, D	0.022	0.206	>0.400
	6 cm, H, 12, D	−0.024	−0.228	>0.400
	6 cm, B, 12, D	−0.079	−0.744	0.234
	H, B, 12, D	0.076	0.714	0.242
6 cm, B......	D	0.376	3.874	<0.005
	H, D	0.404	4.184	<0.005
	X, D	0.214	2.075	0.023
	FIR, D	−0.051	−0.487	0.315
	12, D	−0.068	−0.646	0.261
6 cm, X......	D	0.458	4.919	<0.005
	H, D	0.423	4.429	<0.005
	B, D	0.349	3.533	<0.005
	FIR, D	0.235	2.294	0.014
	12, D	0.194	1.881	0.035
	H, B, D	0.392	4.024	<0.005
	H, FIR, D	0.273	2.675	0.005
	H, 12, D	0.259	2.534	0.008
	B, FIR, D	0.263	2.573	0.007
	B, 12, D	0.221	2.138	0.020
	FIR, 12, D	0.193	1.859	0.036
	H, B, FIR, D	0.273	2.659	0.005
	H, B, 12, D	0.259	2.520	0.008
	H, FIR, 12, D	0.250	2.419	0.010
	B, FIR, 12, D	0.234	2.253	0.016
H, B	D	0.845	15.059	<0.005
	6 cm, D	0.849	15.240	<0.005
	X, D	0.807	12.959	<0.005
	FIR, D	0.848	15.211	<0.005
	12, D	0.821	13.656	<0.005
	6 cm, X, D	0.827	13.899	<0.005
	6 cm, FIR, D	0.848	15.100	<0.005
	6 cm, 12, D	0.823	13.644	<0.005
	X, FIR, D	0.832	14.137	<0.005
	X, 12, D	0.806	12.847	<0.005
	FIR, 12, D	0.838	14.510	<0.005
	6 cm, X, FIR, D	0.829	13.881	<0.005
	6 cm, X, 12, D	0.805	12.724	<0.005
	6 cm, FIR, 12, D	0.836	14.294	<0.005
	X, FIR, 12, D	0.825	13.696	<0.005
B, 12........	D	0.553	6.329	<0.005
	6 cm, D	0.441	4.667	<0.005
	H, D	0.459	4.902	<0.005
	X, D	0.436	4.596	<0.005
	FIR, D	0.240	2.342	0.012
	6 cm, H, D	0.260	2.538	0.008
	6 cm, X, D	0.406	4.193	<0.005
	6 cm, FIR, D	0.260	2.538	0.008
	H, X, D	0.432	4.522	<0.005
	H, FIR, D	0.003	0.031	>0.400
	X, FIR, D	0.187	1.800	0.041
	6 cm, H, X, D	0.260	2.527	0.008
	6 cm, H, FIR, D	0.007	0.065	>0.400
	6 cm, X, FIR, D	0.220	2.114	0.021
	H, X, FIR, D	0.005	0.043	>0.400
B, FIR.......	D	0.520	5.807	<0.005
	6 cm, D	0.390	4.022	<0.005
	H, D	0.535	6.012	<0.005
	X, D	0.409	4.254	<0.005
	12, D	0.098	0.935	0.188
	6 cm, H, D	0.385	3.930	<0.005
	6 cm, X, D	0.378	3.851	<0.005
	6 cm, 12, D	0.135	1.286	0.103
	H, X, D	0.515	5.662	<0.005
	H, 12, D	0.310	3.074	<0.005
	X, 12, D	0.090	0.854	0.208
	6 cm, H, X, D	0.385	3.908	<0.005
	6 cm, H, 12, D	0.294	2.882	<0.005
	6 cm, X, 12, D	0.152	1.442	0.081
	H, X, 12, D	0.310	3.056	<0.005
FIR, 12......	D	0.867	16.593	<0.005
	6 cm, D	0.684	8.892	<0.005
	H, D	0.855	15.640	<0.005
	B, D	0.814	13.300	<0.005
	X, D	0.837	14.487	<0.005

TABLE 10A—*Continued*

Test Pair	Held Parameters	Partial Rank	Test Stat. (*T*)	Prob.
	H, X, *D*	0.371	3.763	<0.005
	H, FIR, *D*	−0.013	−0.124	>0.400
	H, 12, *D*	0.104	0.990	0.175
	X, FIR, *D*	−0.132	−1.255	0.111
	X , 12, *D*	−0.127	−1.204	0.123
	FIR, 12, *D*	−0.115	−1.094	0.150
	H, X, FIR, *D*	−0.011	−0.101	>0.400
	H, X, 12, *D*	0.104	0.985	0.176
	H, FIR, 12, *D*	−0.014	−0.136	>0.400
	X, FIR, 12, *D*	−0.176	−1.674	0.051
H, 12………	*D*	0.386	3.994	<0.005
	6 cm, *D*	0.370	3.775	<0.005
	B, *D*	−0.181	−1.749	0.045
	X, *D*	0.233	2.269	0.015
	FIR, *D*	0.281	2.773	<0.005
	6 cm, *B*, *D*	−0.011	−0.100	>0.400
	6 cm, X, *D*	0.324	3.229	<0.005
	6 cm, FIR, *D*	0.302	2.991	<0.005
	B, X, *D*	−0.224	−2.170	0.019
	B, FIR, *D*	0.150	1.433	0.082
	X, FIR, *D*	0.222	2.151	0.020
	6 cm, *B*, X, *D*	−0.024	−0.224	>0.400
	6 cm, *B*, FIR, *D*	0.160	1.520	0.071
	6 cm, X, FIR, *D*	0.261	2.531	0.008
	B, X, FIR, *D*	0.122	1.151	0.136
H, FIR ……	*D*	0.291	2.903	<0.005
	6 cm, *D*	0.227	2.207	0.017
	B, *D*	−0.324	−3.249	<0.005
	X, *D*	0.134	1.281	0.105
	12, *D*	−0.095	−0.904	0.196
	6 cm, *B*, *D*	−0.215	−2.080	0.022
	6 cm, X, *D*	0.201	1.936	0.031
	6 cm, 12, *D*	−0.039	−0.365	0.359
	B, X, *D*	−0.364	−3.691	<0.005
	B, 12, *D*	−0.309	−3.064	<0.005
	X, 12, *D*	−0.114	−1.084	0.152
	6 cm, *B*, X, *D*	−0.215	−2.063	0.023
	6 cm, *B*, 12, *D*	−0.266	−2.587	0.007
	6 cm, X, 12, *D*	−0.028	−0.258	0.397
	B, X, 12, *D*	−0.317	−3.134	<0.005
6 cm, *H*……	*D*	0.195	1.893	0.034
	B, *D*	−0.248	−2.434	0.009
	X, *D*	−0.006	−0.061	>0.400
	FIR, *D*	−0.052	−0.496	0.312
	12, *D*	−0.154	−1.482	0.076
	B, X, *D*	−0.310	−3.076	<0.005
	B, FIR, *D*	−0.017	−0.156	>0.400
	B, 12, *D*	−0.173	−1.658	0.053
	X, FIR, *D*	−0.151	−1.446	0.081
	X, 12, *D*	−0.232	−2.247	0.016
	FIR, 12, *D*	−0.128	−1.219	0.120
	B, X, FIR, *D*	−0.076	−0.714	0.242
	B, X, 12, *D*	−0.221	−2.124	0.021
	B, FIR, 12, *D*	−0.058	−0.547	0.294
	X, FIR, 12, *D*	−0.205	−1.963	0.029
	6 cm, *H*, *D*	0.663	8.357	<0.005
	6 cm, *B*, *D*	0.619	7.440	<0.005
	6 cm, X, *D*	0.680	8.742	<0.005
	H, *B*, *D*	0.812	13.121	<0.005
	H, X, *D*	0.836	14.356	<0.005
	B, X, *D*	0.802	12.646	<0.005
	6 cm, *H*, *B*, *D*	0.632	7.646	<0.005
	6 cm, *H*, X, *D*	0.663	8.311	<0.005
	6 cm, *B*, X, *D*	0.622	7.451	<0.005
	H, *B*, X, *D*	0.793	12.218	<0.005
6 cm, 12………	*D*	0.748	10.764	<0.005
	H, *D*	0.744	10.566	<0.005
	B, *D*	0.700	9.298	<0.005
	X, *D*	0.681	8.830	<0.005
	FIR, *D*	0.239	2.339	0.012
	H, *B*, *D*	0.687	8.931	<0.005
	H, X, *D*	0.702	9.302	<0.005
	H, FIR, *D*	0.265	2.593	0.007
	B, X, *D*	0.669	8.492	<0.005
	B, FIR, *D*	0.260	2.536	0.008
	X, FIR, *D*	0.199	1.913	0.032
	H, *B*, X, *D*	0.647	7.961	<0.005
	H, *B*, FIR, *D*	0.265	2.579	0.007
	H, X, FIR, *D*	0.241	2.331	0.013
	B, X, FIR, *D*	0.229	2.212	0.017
6 cm, FIR……	*D*	0.777	11.757	<0.005
	H, *D*	0.767	11.346	<0.005
	B, *D*	0.734	10.254	<0.005
	X, *D*	0.725	9.979	<0.005
	12, *D*	0.386	3.974	<0.005
	H, *B*, *D*	0.713	9.597	<0.005
	H, X, *D*	0.732	10.142	<0.005
	H, 12, *D*	0.378	3.852	<0.005
	B, X, *D*	0.715	9.648	<0.005
	B, 12, *D*	0.396	4.067	<0.005
	X, 12, *D*	0.386	3.946	<0.005
	H, *B*, X, *D*	0.680	8.699	<0.005
	H, *B*, 12, *D*	0.366	3.684	<0.005
	H, X, 12, *D*	0.372	3.759	<0.005
	B, X, 12, *D*	0.402	4.121	<0.005

TABLE 10B

SPEARMAN PARTIAL RANK ANALYSIS ON THE $T = 0$–2 SAMPLE ($N = 23$) (NO AMORPHOUS GALAXIES)

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.	Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
B, X ………	*D*	0.423	2.085	0.025	6 cm, X……	*D*	0.228	1.046	0.167
	6 cm, *D*	0.368	1.726	0.050		*H*, *D*	0.181	0.801	0.224
	H, *D*	0.143	0.631	0.268		*B*, *D*	0.047	0.204	>0.400
	FIR, *D*	0.445	2.165	0.023		FIR, *D*	0.308	1.411	0.090
	12, *D*	0.397	1.887	0.039		12, *D*	0.172	0.761	0.233
	6 cm, *H*, *D*	0.056	0.240	>0.400		*H*, *B*, *D*	0.125	0.533	0.299
	6 cm, FIR, *D*	0.390	1.798	0.045		*H*, FIR, *D*	0.263	1.158	0.140
	6 cm, 12, *D*	0.372	1.702	0.053		*H*, 12, *D*	0.126	0.537	0.298
	H, FIR, *D*	0.167	0.718	0.243		*B*, FIR, *D*	0.208	0.903	0.200
	H, 12, *D*	0.087	0.371	0.359		*B*, 12, *D*	0.087	0.370	0.359
	FIR, 12, *D*	0.418	1.950	0.035		FIR, 12, *D*	0.195	0.845	0.214
	6 cm, *H*, FIR, *D*	0.104	0.430	0.337		*H*, *B*, FIR, *D*	0.230	0.975	0.183
	6 cm, *H*, 12, *D*	0.062	0.255	>0.400		*H*, *B*, 12, *D*	0.110	0.455	0.328
	6 cm, FIR, 12, *D*	0.390	1.745	0.050		*H*, FIR, 12, *D*	0.150	0.624	0.271
	H, FIR, 12, *D*	0.125	0.519	0.304		*B*, FIR, 12, *D*	0.109	0.453	0.328
H, X ………	*D*	0.439	2.186	0.022	*H*, *B* ………	*D*	0.779	5.548	<0.005
	6 cm, *D*	0.420	2.018	0.030		6 cm, *D*	0.804	5.894	<0.005
	B, *D*	0.193	0.860	0.210		X, *D*	0.728	4.632	<0.005
	FIR, *D*	0.439	2.128	0.024		FIR, *D*	0.817	6.174	<0.005
	12, *D*	0.432	2.089	0.025		12, *D*	0.813	6.091	<0.005
	6 cm, *B*, *D*	0.224	0.977	0.183		6 cm, X, *D*	0.770	5.114	<0.005
	6 cm, FIR, *D*	0.412	1.918	0.037		6 cm, FIR, *D*	0.814	5.944	<0.005
	6 cm, 12, *D*	0.419	1.956	0.035		6 cm, 12, *D*	0.811	5.885	<0.005
	B, FIR, *D*	0.146	0.625	0.270		X, FIR, *D*	0.773	5.162	<0.005
	B, 12, *D*	0.204	0.886	0.204		X, 12, *D*	0.775	5.206	<0.005
	FIR, 12, *D*	0.432	2.030	0.030		FIR, 12, *D*	0.817	6.006	<0.005
	6 cm, *B*, FIR, *D*	0.176	0.739	0.239		6 cm, X, FIR, *D*	0.779	5.115	<0.005
	6 cm, *B*, 12, *D*	0.215	0.907	0.199		6 cm, X, 12, *D*	0.777	5.097	<0.005
	6 cm, FIR, 12, *D*	0.416	1.886	0.040		6 cm, FIR, 12, *D*	0.814	5.782	<0.005
	B, FIR, 12, *D*	0.173	0.724	0.242		X, FIR, 12, *D*	0.777	5.082	<0.005
X, 12 ……..	*D*	0.158	0.714	0.244	*B*, 12………	*D*	0.397	1.933	0.036
	6 cm, *D*	−0.045	−0.195	>0.400		6 cm, *D*	0.066	0.288	0.390
	H, *D*	0.133	0.584	0.283		*H*, *D*	0.525	2.687	0.008
	B, *D*	−0.012	−0.053	>0.400		X, *D*	0.369	1.730	0.050
	FIR, *D*	0.288	1.313	0.104		FIR, *D*	0.178	0.788	0.227
	6 cm, *H*, *D*	−0.022	−0.092	>0.400		6 cm, *H*, *D*	0.192	0.828	0.218
	6 cm, *B*, *D*	−0.074	−0.316	0.379		6 cm, X, *D*	0.089	0.377	0.357
	6 cm, FIR, *D*	0.161	0.690	0.250		6 cm, FIR, *D*	0.036	0.152	>0.400
	H, *B*, *D*	0.068	0.291	0.389		*H*, X, *D*	0.516	2.553	0.010
	H, FIR, *D*	0.276	1.219	0.126		*H*, FIR, *D*	0.176	0.759	0.234
	B, FIR, *D*	0.237	1.037	0.169		X, FIR, *D*	0.058	0.246	>0.400
	6 cm, *H*, *B*, *D*	−0.033	−0.137	>0.400		6 cm, *H*, X, *D*	0.193	0.812	0.221
	6 cm, *H*, FIR, *D*	0.172	0.722	0.243		6 cm, *H*, FIR, *D*	0.050	0.206	>0.400
	6 cm, *B*, FIR, *D*	0.159	0.665	0.258		6 cm, X, FIR, *D*	−0.030	−0.122	>0.400
	H, *B*, FIR, *D*	0.254	1.084	0.158		*H*, X, FIR, *D*	0.137	0.571	0.287
X, FIR ……	*D*	0.022	0.099	>0.400	*B*, FIR…….	*D*	0.362	1.734	0.049
	6 cm, *D*	−0.214	−0.955	0.188		6 cm, *D*	0.057	0.249	>0.400
	H, *D*	0.001	0.003	>0.400		*H*, *D*	0.515	2.622	0.009
	B, *D*	−0.155	−0.682	0.253		X, *D*	0.389	1.839	0.042
	12, *D*	−0.245	−1.104	0.153		12, *D*	0.030	0.131	>0.400
	6 cm, *H*, *D*	−0.195	−0.842	0.214		6 cm, *H*, *D*	0.220	0.956	0.188
	6 cm, *B*, *D*	−0.253	−1.111	0.151		6 cm, X, *D*	0.150	0.642	0.265
	6 cm, 12, *D*	−0.262	−1.151	0.142		6 cm, 12, *D*	0.014	0.060	>0.400
	H, *B*, *D*	−0.086	−0.368	0.360		*H*, X, *D*	0.521	2.588	0.009
	H, 12, *D*	−0.244	−1.069	0.161		*H*, 12, *D*	0.134	0.575	0.286
	B, 12, *D*	−0.281	−1.240	0.121		X, 12, *D*	0.143	0.615	0.273
	6 cm, *H*, *B*, *D*	−0.213	−0.897	0.202		6 cm, *H*, X, *D*	0.236	1.000	0.177
	6 cm, *H*, 12, *D*	−0.257	−1.096	0.155		6 cm, *H*, 12, *D*	0.121	0.501	0.311
	6 cm, *B*, 12, *D*	−0.288	−1.239	0.121		6 cm, X, 12, *D*	0.125	0.518	0.305
	H, *B*, 12, *D*	−0.259	−1.107	0.152		*H*, X, 12, *D*	0.161	0.673	0.255
6 cm, *B*……	*D*	0.449	2.249	0.020	FIR, 12……	*D*	0.878	8.191	<0.005
	H, *D*	0.533	2.742	0.007		6 cm, *D*	0.718	4.500	<0.005
	X, *D*	0.400	1.903	0.038		*H*, *D*	0.878	7.989	<0.005
	FIR, *D*	0.291	1.328	0.101		*B*, *D*	0.858	7.280	<0.005
	12, *D*	0.238	1.070	0.161		X, *D*	0.885	8.307	<0.005

TABLE 10B—*Continued*

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
	H, X, D	0.520	2.586	0.009
	H, FIR, D	0.267	1.178	0.136
	H, 12, D	0.218	0.948	0.189
	X, FIR, D	0.181	0.782	0.229
	X, 12, D	0.188	0.813	0.221
	FIR, 12, D	0.237	1.035	0.169
	H, X, FIR, D	0.235	0.997	0.178
	H, X, 12, D	0.210	0.884	0.204
	H, FIR, 12, D	0.210	0.887	0.204
	X, FIR, 12, D	0.174	0.730	0.241
H, 12………	D	0.088	0.397	0.349
	6 cm, D	−0.060	−0.260	0.400
	B, D	−0.383	−1.807	0.045
	X, D	0.022	0.094	>0.400
	FIR, D	0.094	0.412	0.344
	6 cm, B, D	−0.190	−0.819	0.220
	6 cm, X, D	−0.045	−0.191	>0.400
	6 cm, FIR, D	0.008	0.035	>0.400
	B, X, D	−0.388	−1.786	0.046
	B, FIR, D	−0.090	−0.386	0.354
	X, FIR, D	−0.038	−0.160	>0.400
	6 cm, B, X, D	−0.178	−0.746	0.237
	6 cm, B, FIR, D	−0.036	−0.148	>0.400
	6 cm, X, FIR, D	−0.064	−0.266	0.398
	B, X, FIR, D	−0.130	−0.541	0.296
H, FIR ……	D	0.049	0.221	>0.400
	6 cm, D	−0.091	−0.398	0.349
	B, D	−0.397	−1.884	0.039
	X, D	0.044	0.193	>0.400
	12, D	−0.059	−0.257	>0.400
	6 cm, B, D	−0.231	−1.005	0.176
	6 cm, X, D	−0.001	−0.005	>0.400
	6 cm, 12, D	−0.069	−0.295	0.387
	B, X, D	−0.378	−1.734	0.050
	B, 12, D	−0.143	−0.615	0.273
	X, 12, D	0.054	0.229	>0.400
	6 cm, B, X, D	−0.184	−0.773	0.231
	6 cm, B, 12, D	−0.138	−0.575	0.286
	6 cm, X, 12, D	0.046	0.190	>0.400
	B, X, 12, D	−0.092	−0.379	0.356
6 cm, H……	D	0.153	0.692	0.249
	B, D	−0.351	−1.635	0.062
	X, D	0.061	0.265	0.398
	FIR, D	0.171	0.755	0.235
	12, D	0.139	0.610	0.275
	B, X, D	−0.368	−1.677	0.057
	B, FIR, D	−0.122	−0.522	0.303
	B, 12, D	−0.098	−0.417	0.342
	X, FIR, D	0.042	0.176	>0.400
	X, 12, D	0.072	0.307	0.382
	FIR, 12, D	0.143	0.614	0.274
	B, X, FIR, D	−0.158	−0.658	0.260
	B, X, 12, D	−0.119	−0.492	0.314
	B, FIR, 12, D	−0.090	−0.372	0.359
	X, FIR, 12, D	0.067	0.275	0.394
	6 cm, H, D	0.717	4.365	<0.005
	6 cm, B, D	0.717	4.367	<0.005
	6 cm, X, D	0.726	4.482	<0.005
	H, B, D	0.833	6.378	<0.005
	H, X, D	0.886	8.090	<0.005
	B, X, D	0.867	7.367	<0.005
	6 cm, H, B, D	0.705	4.098	<0.005
	6 cm, H, X, D	0.727	4.364	<0.005
	6 cm, B, X, D	0.724	4.327	<0.005
	H, B, X, D	0.844	6.479	<0.005
6 cm, 12……..	D	0.806	6.079	<0.005
	H, D	0.805	5.906	<0.005
	B, D	0.765	5.176	<0.005
	X, D	0.800	5.820	<0.005
	FIR, D	0.510	2.582	0.009
	H, B, D	0.729	4.516	<0.005
	H, X, D	0.801	5.672	<0.005
	H, FIR, D	0.503	2.470	0.013
	B, X, D	0.766	5.061	<0.005
	B, FIR, D	0.486	2.361	0.016
	X, FIR, D	0.462	2.210	0.021
	H, B, X, D	0.728	4.374	<0.005
	H, B, FIR, D	0.481	2.261	0.020
	H, X, FIR, D	0.464	2.161	0.023
	B, X, FIR, D	0.460	2.135	0.024
6 cm, FIR……	D	0.727	4.729	<0.005
	H, D	0.728	4.635	<0.005
	B, D	0.677	4.013	<0.005
	X, D	0.741	4.813	<0.005
	12, D	0.069	0.301	0.385
	H, B, D	0.626	3.405	<0.005
	H, X, D	0.741	4.676	<0.005
	H, 12, D	0.078	0.332	0.373
	B, X, D	0.694	4.085	<0.005
	B, 12, D	0.064	0.271	0.396
	X, 12, D	0.116	0.497	0.312
	H, B, X, D	0.644	3.472	<0.005
	H, B, 12, D	0.050	0.208	>0.400
	H, X, 12, D	0.113	0.469	0.323
	B, X, 12, D	0.092	0.381	0.355

TABLE 10C

Spearman Partial Rank Analysis on the T = 3–4 Sample (N = 29)

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
B, X	D	0.249	1.310	0.102
	6 cm, D	0.240	1.234	0.120
	H, D	0.046	0.228	>0.400
	FIR, D	0.081	0.406	0.346
	12, D	0.028	0.138	>0.400
	6 cm, H, D	0.004	0.017	>0.400
	6 cm, FIR, D	0.117	0.577	0.284
	6 cm, 12, D	0.028	0.138	>0.400
	H, FIR, D	−0.086	−0.423	0.340
	H, 12, D	−0.064	−0.313	0.381
	FIR, 12, D	0.018	0.088	>0.400
	6 cm, H, FIR, D	−0.071	−0.343	0.369
	6 cm, H, 12, D	−0.062	−0.299	0.386
	6 cm, FIR, 12, D	0.005	0.026	>0.400
	H, FIR, 12, D	−0.093	−0.449	0.330
H, X	D	0.247	1.302	0.104
	6 cm, D	0.251	1.296	0.106
	B, D	0.036	0.180	>0.400
	FIR, D	0.114	0.576	0.285
	12, D	0.052	0.258	>0.400
	6 cm, B, D	0.077	0.378	0.356
	6 cm, FIR, D	0.148	0.734	0.237
	6 cm, 12, D	0.054	0.266	0.398
	B, FIR, D	0.118	0.583	0.282
	B, 12, D	0.077	0.379	0.356
	FIR, 12, D	0.051	0.252	>0.400
	6 cm, B, FIR, D	0.116	0.560	0.291
	6 cm, B, 12, D	0.078	0.373	0.358
	6 cm, FIR, 12, D	0.042	0.204	>0.400
	B, FIR, 12, D	0.105	0.505	0.309
X, 12	D	0.604	3.863	<0.005
	6 cm, D	0.409	2.244	0.019
	H, D	0.570	3.470	<0.005
	B, D	0.569	3.455	<0.005
	FIR, D	0.305	1.599	0.064
	6 cm, H, D	0.338	1.760	0.046
	6 cm, B, D	0.343	1.789	0.044
	6 cm, FIR, D	0.263	1.337	0.098
	H, B, D	0.571	3.410	<0.005
	H, FIR, D	0.288	1.476	0.080
	B, FIR, D	0.295	1.513	0.075
	6 cm, H, B, D	0.343	1.752	0.047
	6 cm, H, FIR, D	0.224	1.102	0.152
	6 cm, B, FIR, D	0.238	1.173	0.135
	H, B, FIR, D	0.290	1.456	0.083
X, FIR	D	0.573	3.564	<0.005
	6 cm, D	0.378	2.042	0.026
	H, D	0.542	3.225	<0.005
	B, D	0.537	3.184	<0.005
	12, D	0.202	1.031	0.168
	6 cm, H, D	0.325	1.681	0.054
	6 cm, B, D	0.321	1.661	0.056
	6 cm, 12, D	0.204	1.022	0.170
	H, B, D	0.545	3.189	<0.005
	H, 12, D	0.202	1.010	0.173
	B, 12, D	0.201	1.005	0.174
	6 cm, H, B, D	0.332	1.685	0.053
	6 cm, H, 12, D	0.201	0.986	0.179
	6 cm, B, 12, D	0.202	0.991	0.178
	H, B, 12, D	0.213	1.044	0.166
6 cm, B	D	0.083	0.422	0.340
	H, D	0.087	0.437	0.335
	X, D	−0.045	−0.228	>0.400
	FIR, D	−0.199	−1.015	0.171
	12, D	−0.411	−2.257	0.018
6 cm, X	D	0.486	2.839	<0.005
	H, D	0.488	2.795	<0.005
	B, D	0.483	2.756	0.006
	FIR, D	0.162	0.819	0.217
	12, D	−0.005	−0.025	>0.400
	H, B, D	0.486	2.727	0.006
	H, FIR, D	0.187	0.931	0.191
	H, 12, D	0.017	0.085	>0.400
	B, FIR, D	0.182	0.907	0.197
	B, 12, D	0.007	0.035	>0.400
	FIR, 12, D	−0.031	−0.152	>0.400
	H, B, FIR, D	0.181	0.881	0.205
	H, B, 12, D	0.011	0.051	>0.400
	H, FIR, 12, D	−0.011	−0.054	>0.400
	B, FIR, 12, D	−0.026	−0.124	>0.400
H, B	D	0.950	15.592	<0.005
	6 cm, D	0.951	15.296	<0.005
	X, D	0.947	14.774	<0.005
	FIR, D	0.947	14.752	<0.005
	12, D	0.944	14.261	<0.005
	6 cm, X, D	0.947	14.503	<0.005
	6 cm, FIR, D	0.945	14.191	<0.005
	6 cm, 12, D	0.933	12.658	<0.005
	X, FIR, D	0.947	14.461	<0.005
	X, 12, D	0.944	13.999	<0.005
	FIR, 12, D	0.945	14.093	<0.005
	6 cm, X, FIR, D	0.945	13.825	<0.005
	6 cm, X, 12, D	0.933	12.413	<0.005
	6 cm, FIR, 12, D	0.933	12.463	<0.005
	X, FIR, 12, D	0.945	13.861	<0.005
B, 12	D	0.378	2.084	0.024
	6 cm, D	0.532	3.143	<0.005
	H, D	0.170	0.864	0.207
	X, D	0.295	1.546	0.071
	FIR, D	0.211	1.078	0.157
	6 cm, H, D	0.181	0.901	0.198
	6 cm, X, D	0.490	2.754	0.006
	6 cm, FIR, D	0.426	2.309	0.016
	H, X, D	0.176	0.875	0.204
	H, FIR, D	0.011	0.053	>0.400
	X, FIR, D	0.196	0.979	0.180
	6 cm, H, X, D	0.191	0.932	0.192
	6 cm, H, FIR, D	0.094	0.454	0.328
	6 cm, X, FIR, D	0.413	2.174	0.021
	H, X, FIR, D	0.037	0.180	>0.400
B, FIR	D	0.325	1.751	0.047
	6 cm, D	0.367	1.975	0.031
	H, D	0.214	1.097	0.152
	X, D	0.230	1.179	0.133
	12, D	0.050	0.249	>0.400
	6 cm, H, D	0.214	1.074	0.158
	6 cm, X, D	0.308	1.586	0.066
	6 cm, 12, D	0.112	0.552	0.293
	H, X, D	0.226	1.136	0.143
	H, 12, D	0.133	0.655	0.258
	X, 12, D	0.045	0.221	>0.400
	6 cm, H, X, D	0.225	1.109	0.150
	6 cm, H, 12, D	0.150	0.726	0.241
	6 cm, X, 12, D	0.109	0.523	0.302
	H, X, 12, D	0.149	0.721	0.243
FIR, 12	D	0.783	6.416	<0.005
	6 cm, D	0.541	3.212	<0.005
	H, D	0.763	5.893	<0.005
	B, D	0.754	5.737	<0.005
	X, D	0.669	4.498	<0.005

TABLE 10C—*Continued*

Test Pair	Held Parameters	Partial Rank	Test Stat. (*T*)	Prob.
	H, X, *D*	0.074	0.365	0.361
	H, FIR, *D*	−0.087	−0.426	0.339
	H, 12, *D*	−0.106	−0.524	0.302
	X, FIR, *D*	−0.216	−1.082	0.156
	X, 12, *D*	−0.411	−2.211	0.020
	FIR, 12, *D*	−0.421	−2.277	0.017
	H, X, FIR, *D*	−0.072	−0.346	0.368
	H, X, 12, *D*	−0.106	−0.509	0.308
	H, FIR, 12, *D*	−0.127	−0.615	0.273
	X, FIR, 12, *D*	−0.421	−2.227	0.020
H, 12………	*D*	0.346	1.879	0.038
	6 cm, *D*	0.509	2.957	<0.005
	B, *D*	−0.048	−0.240	>0.400
	X, *D*	0.254	1.314	0.101
	FIR, *D*	0.219	1.122	0.146
	6 cm, *B*, *D*	0.012	0.059	>0.400
	6 cm, X, *D*	0.460	2.538	0.009
	6 cm, FIR, *D*	0.422	2.277	0.017
	B, X, *D*	−0.083	−0.410	0.345
	B, FIR, *D*	0.062	0.302	0.384
	X, FIR, *D*	0.195	0.972	0.182
	6 cm, *B*, X, *D*	−0.015	−0.073	>0.400
	6 cm, *B*, FIR, *D*	0.063	0.301	0.385
	6 cm, X, FIR, *D*	0.401	2.099	0.024
	B, X, FIR, *D*	0.028	0.135	>0.400
H, FIR ……	*D*	0.274	1.454	0.083
	6 cm, *D*	0.320	1.690	0.053
	B, *D*	−0.117	−0.589	0.280
	X, *D*	0.167	0.846	0.211
	12, *D*	0.006	0.031	>0.400
	6 cm, *B*, *D*	−0.100	−0.494	0.313
	6 cm, X, *D*	0.251	1.273	0.111
	6 cm, 12, *D*	0.062	0.305	0.383
	B, X, *D*	−0.162	−0.803	0.221
	B, 12, *D*	−0.123	−0.608	0.274
	X, 12, *D*	−0.004	−0.021	>0.400
	6 cm, *B*, X, *D*	−0.132	−0.641	0.265
	6 cm, *B*, 12, *D*	−0.118	−0.568	0.288
	6 cm, X, 12, *D*	0.052	0.251	>0.400
	B, X, 12, *D*	−0.142	−0.688	0.251
6 cm, *H*……	*D*	0.058	0.299	0.386
	B, *D*	−0.065	−0.324	0.376
	X, *D*	−0.073	−0.366	0.361
	FIR, *D*	−0.181	−0.921	0.193
	12, *D*	−0.402	−2.194	0.020
	B, X, *D*	−0.094	−0.461	0.326
	B, FIR, *D*	0.023	0.112	>0.400
	B, 12, *D*	−0.045	−0.220	>0.400
	X, FIR, *D*	−0.204	−1.019	0.170
	X, 12, *D*	−0.402	−2.151	0.022
	FIR, 12, *D*	−0.406	−2.175	0.021
	B, X, FIR, *D*	0.001	0.007	>0.400
	B, X, 12, *D*	−0.046	−0.219	>0.400
	B, FIR, 12, *D*	−0.026	−0.124	>0.400
	X, FIR, 12, *D*	−0.405	−2.124	0.023

Test Pair	Held Parameters	Partial Rank	Test Stat. (*T*)	Prob.
	6 cm, *H*, *D*	0.463	2.559	0.009
	6 cm, *B*, *D*	0.438	2.388	0.014
	6 cm, X, *D*	0.457	2.515	0.010
	H, *B*, *D*	0.754	5.628	<0.005
	H, X, *D*	0.657	4.267	<0.005
	B, X, *D*	0.646	4.149	<0.005
	6 cm, *H*, *B*, *D*	0.442	2.361	0.015
	6 cm, *H*, X, *D*	0.397	2.074	0.025
	6 cm, *B*, X, *D*	0.369	1.902	0.037
	H, *B*, X, *D*	0.644	4.032	<0.005
6 cm, 12……..	*D*	0.809	7.029	<0.005
	H, *D*	0.843	7.821	<0.005
	B, *D*	0.844	7.854	<0.005
	X, *D*	0.740	5.509	<0.005
	FIR, *D*	0.608	3.828	<0.005
	H, *B*, *D*	0.843	7.683	<0.005
	H, X, *D*	0.787	6.248	<0.005
	H, FIR, *D*	0.675	4.480	<0.005
	B, X, *D*	0.790	6.311	<0.005
	B, FIR, *D*	0.678	4.523	<0.005
	X, FIR, *D*	0.594	3.621	<0.005
	H, *B*, X, *D*	0.788	6.145	<0.005
	H, *B*, FIR, *D*	0.678	4.429	<0.005
	H, X, FIR, *D*	0.660	4.215	<0.005
	B, X, FIR, *D*	0.665	4.269	<0.005
6 cm, FIR……	*D*	0.679	4.722	<0.005
	H, *D*	0.691	4.780	<0.005
	B, *D*	0.692	4.798	<0.005
	X, *D*	0.560	3.376	<0.005
	12, *D*	0.125	0.631	0.266
	H, *B*, *D*	0.691	4.683	<0.005
	H, X, *D*	0.582	3.502	<0.005
	H, 12, *D*	0.140	0.690	0.248
	B, X, *D*	0.586	3.546	<0.005
	B, 12, *D*	0.160	0.794	0.223
	X, 12, *D*	0.129	0.637	0.264
	H, *B*, X, *D*	0.581	3.426	<0.005
	H, *B*, 12, *D*	0.156	0.757	0.234
	H, X, 12, *D*	0.139	0.673	0.255
	B, X, 12, *D*	0.162	0.787	0.227

TABLE 10D

SPEARMAN PARTIAL RANK ANALYSIS ON THE $T = 5$–10 SAMPLE ($N = 38$)

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
B, X	*D*	0.445	2.936	<0.005
	6 cm, *D*	0.277	1.681	0.052
	H, *D*	0.260	1.567	0.067
	FIR, *D*	−0.045	−0.265	0.398
	12, *D*	0.102	0.598	0.277
	6 cm, *H*, *D*	0.249	1.479	0.078
	6 cm, FIR, *D*	−0.005	−0.028	>0.400
	6 cm, 12, *D*	0.099	0.574	0.285
	H, FIR, *D*	0.228	1.347	0.095
	H, 12, *D*	0.285	1.710	0.049
	FIR, 12, *D*	−0.037	−0.213	>0.400
	6 cm, *H*, FIR, *D*	0.231	1.341	0.096
	6 cm, *H*, 12, *D*	0.270	1.584	0.065
	6 cm, FIR, 12, *D*	−0.002	−0.011	>0.400
	H, FIR, 12, *D*	0.235	1.371	0.092
H, X	*D*	0.390	2.506	0.009
	6 cm, *D*	0.206	1.228	0.119
	B, *D*	−0.120	−0.706	0.244
	FIR, *D*	−0.174	−1.031	0.166
	12, *D*	−0.037	−0.217	>0.400
	6 cm, *B*, *D*	−0.166	−0.965	0.182
	6 cm, FIR, *D*	−0.135	−0.781	0.226
	6 cm, 12, *D*	−0.031	−0.178	>0.400
	B, FIR, *D*	−0.281	−1.682	0.052
	B, 12, *D*	−0.270	−1.613	0.061
	FIR, 12, *D*	−0.175	−1.021	0.169
	6 cm, *B*, FIR, *D*	−0.265	−1.556	0.068
	6 cm, *B*, 12, *D*	−0.254	−1.483	0.078
	6 cm, FIR, 12, *D*	−0.141	−0.807	0.220
	B, FIR, 12, *D*	−0.288	−1.703	0.050
X, 12	*D*	0.510	3.505	<0.005
	6 cm, *D*	0.302	1.847	0.039
	H, *D*	0.358	2.237	0.018
	B, *D*	0.295	1.802	0.043
	FIR, *D*	−0.034	−0.201	>0.400
	6 cm, *H*, *D*	0.228	1.343	0.096
	6 cm, *B*, *D*	0.160	0.928	0.191
	6 cm, FIR, *D*	−0.011	−0.062	>0.400
	H, *B*, *D*	0.376	2.331	0.015
	H, FIR, *D*	0.039	0.223	>0.400
	B, FIR, *D*	−0.022	−0.127	>0.400
	6 cm, *H*, *B*, *D*	0.250	1.460	0.081
	6 cm, *H*, FIR, *D*	0.044	0.249	>0.400
	6 cm, *B*, FIR, *D*	−0.010	−0.056	>0.400
	H, *B*, FIR, *D*	0.071	0.402	0.347
X, FIR	*D*	0.606	4.509	<0.005
	6 cm, *D*	0.387	2.446	0.010
	H, *D*	0.526	3.606	<0.005
	B, *D*	0.462	3.037	<0.005
	12, *D*	0.383	2.416	0.012
	6 cm, *H*, *D*	0.358	2.202	0.019
	6 cm, *B*, *D*	0.281	1.683	0.052
	6 cm, 12, *D*	0.254	1.508	0.075
	H, *B*, *D*	0.515	3.448	<0.005
	H, 12, *D*	0.414	2.614	0.007
	B, 12, *D*	0.372	2.305	0.016
	6 cm, *H*, *B*, *D*	0.346	2.086	0.023
	6 cm, *H*, 12, *D*	0.287	1.693	0.051
	6 cm, *B*, 12, *D*	0.235	1.366	0.093
	H, *B*, 12, *D*	0.385	2.358	0.014
6 cm, *B*......	*D*	0.442	2.919	<0.005
	H, *D*	0.082	0.478	0.319
	X, *D*	0.273	1.656	0.056
	FIR, *D*	−0.235	−1.410	0.087
	12, *D*	0.025	0.144	>0.400
6 cm, X......	*D*	0.528	3.677	<0.005
	H, *D*	0.431	2.781	<0.005
	B, *D*	0.412	2.638	0.007
	FIR, *D*	0.174	1.029	0.167
	12, *D*	0.338	2.095	0.023
	H, *B*, *D*	0.425	2.699	0.006
	H, FIR, *D*	0.134	0.778	0.227
	H, 12, *D*	0.338	2.060	0.024
	B, FIR, *D*	0.168	0.979	0.179
	B, 12, *D*	0.337	2.059	0.024
	FIR, 12, *D*	0.171	0.996	0.175
	H, *B*, FIR, *D*	0.138	0.790	0.224
	H, *B*, 12, *D*	0.325	1.943	0.032
	H, FIR, 12, *D*	0.136	0.775	0.227
	B, FIR, 12, *D*	0.167	0.957	0.184
H, *B*	*D*	0.952	18.346	<0.005
	6 cm, *D*	0.940	16.070	<0.005
	X, *D*	0.944	16.629	<0.005
	FIR, *D*	0.878	10.708	<0.005
	12, *D*	0.881	10.880	<0.005
	6 cm, X, *D*	0.939	15.692	<0.005
	6 cm, FIR, *D*	0.871	10.165	<0.005
	6 cm, 12, *D*	0.883	10.779	<0.005
	X, FIR, *D*	0.885	10.904	<0.005
	X, 12, *D*	0.890	11.239	<0.005
	FIR, 12, *D*	0.868	10.055	<0.005
	6 cm, X, FIR, *D*	0.878	10.374	<0.005
	6 cm, X, 12, *D*	0.890	11.067	<0.005
	6 cm, FIR, 12, *D*	0.862	9.621	<0.005
	X, FIR, 12, *D*	0.876	10.271	<0.005
B, 12.........	*D*	0.760	6.924	<0.005
	6 cm, *D*	0.690	5.553	<0.005
	H, *D*	−0.019	−0.112	>0.400
	X, *D*	0.693	5.597	<0.005
	FIR, *D*	0.294	1.791	0.043
	6 cm, *H*, *D*	−0.056	−0.322	0.377
	6 cm, X, *D*	0.662	5.068	<0.005
	6 cm, FIR, *D*	0.271	1.619	0.060
	H, X, *D*	−0.124	−0.720	0.240
	H, FIR, *D*	−0.130	−0.752	0.233
	X, FIR, *D*	0.292	1.757	0.046
	6 cm, *H*, X, *D*	−0.120	−0.681	0.250
	6 cm, *H*, FIR, *D*	−0.130	−0.741	0.235
	6 cm, X, FIR, *D*	0.271	1.594	0.064
	H, X, FIR, *D*	−0.142	−0.814	0.218
B, FIR.......	*D*	0.771	7.168	<0.005
	6 cm, *D*	0.724	6.118	<0.005
	H, *D*	0.127	0.748	0.234
	X, *D*	0.704	5.785	<0.005
	12, *D*	0.350	2.179	0.020
	6 cm, *H*, *D*	0.098	0.566	0.288
	6 cm, X, *D*	0.696	5.569	<0.005
	6 cm, 12, *D*	0.399	2.498	0.009
	H, X, *D*	−0.011	−0.065	>0.400
	H, 12, *D*	0.180	1.051	0.162
	X, 12, *D*	0.338	2.066	0.024
	6 cm, *H*, X, *D*	0.010	0.055	>0.400
	6 cm, *H*, 12, *D*	0.152	0.873	0.204
	6 cm, X, 12, *D*	0.388	2.383	0.013
	H, X, 12, *D*	0.071	0.402	0.347
FIR, 12......	*D*	0.864	10.136	<0.005
	6 cm, *D*	0.796	7.676	<0.005
	H, *D*	0.632	4.759	<0.005
	B, *D*	0.671	5.271	<0.005
	X, *D*	0.811	8.072	<0.005

TABLE 10D—*Continued*

Test Pair	Held Parameters	Partial Rank	Test Stat. (T)	Prob.
	H, X, *D*	−0.035	−0.198	>0.400
	H, FIR, *D*	−0.002	−0.013	>0.400
	H, 12, *D*	0.097	0.560	0.290
	X, FIR, *D*	−0.231	−1.363	0.093
	X, 12, *D*	−0.010	−0.060	>0.400
	FIR, 12, *D*	−0.205	−1.206	0.125
	H, X, FIR, *D*	−0.034	−0.193	>0.400
	H, X, 12, *D*	0.001	0.004	>0.400
	H, FIR, 12, *D*	−0.007	−0.039	>0.400
	X, FIR, 12, *D*	−0.202	−1.168	0.134
H, 12	*D*	0.803	7.958	<0.005
	6 cm, *D*	0.747	6.555	<0.005
	B, *D*	0.396	2.515	0.009
	X, *D*	0.762	6.863	<0.005
	FIR, *D*	0.399	2.538	0.009
	6 cm, *B*, *D*	0.400	2.509	0.009
	6 cm, X, *D*	0.734	6.213	<0.005
	6 cm, FIR, *D*	0.380	2.357	0.014
	B, X, *D*	0.455	2.935	<0.005
	B, FIR, *D*	0.309	1.866	0.038
	X, FIR, *D*	0.399	2.503	0.009
	6 cm, *B*, X, *D*	0.438	2.758	<0.005
	6 cm, *B*, FIR, *D*	0.303	1.797	0.043
	6 cm, X, FIR, *D*	0.382	2.336	0.014
	B, X, FIR, *D*	0.316	1.881	0.037
H, FIR	*D*	0.785	7.495	<0.005
	6 cm, *D*	0.746	6.540	<0.005
	B, *D*	0.261	1.574	0.066
	X, *D*	0.749	6.591	<0.005
	12, *D*	0.305	1.869	0.038
	6 cm, *B*, *D*	0.280	1.677	0.053
	6 cm, X, *D*	0.739	6.298	<0.005
	6 cm, 12, *D*	0.377	2.336	0.014
	B, X, *D*	0.359	2.210	0.019
	B, 12, *D*	−0.007	−0.042	>0.400
	X, 12, *D*	0.346	2.119	0.022
	6 cm, *B*, X, *D*	0.345	2.081	0.024
	6 cm, *B*, 12, *D*	0.057	0.324	0.376
	6 cm, X, 12, *D*	0.398	2.452	0.010
	B, X, 12, *D*	0.104	0.594	0.279
6 cm, *H*	*D*	0.441	2.909	<0.005
	B, *D*	0.073	0.428	0.338
	X, *D*	0.301	1.840	0.040
	FIR, *D*	−0.266	−1.612	0.061
	12, *D*	−0.024	−0.140	>0.400
	B, X, *D*	0.136	0.788	0.224
	B, FIR, *D*	−0.129	−0.748	0.234
	B, 12, *D*	−0.097	−0.559	0.290
	X, FIR, *D*	−0.244	−1.442	0.083
	X, 12, *D*	−0.012	−0.069	>0.400
	FIR, 12, *D*	−0.233	−1.375	0.092
	B, X, FIR, *D*	−0.087	−0.492	0.314
	B, X, 12, *D*	−0.006	−0.035	>0.400
	B, FIR, 12, *D*	−0.112	−0.638	0.264
	X, FIR, 12, *D*	−0.209	−1.210	0.124
	6 cm, *H*, *D*	0.539	3.681	<0.005
	6 cm, *B*, *D*	0.595	4.249	<0.005
	6 cm, X, *D*	0.773	6.998	<0.005
	H, *B*, *D*	0.640	4.785	<0.005
	H, X, *D*	0.559	3.873	<0.005
	B, X, *D*	0.630	4.666	<0.005
	6 cm, *H*, *B*, *D*	0.548	3.710	<0.005
	6 cm, *H*, X, *D*	0.504	3.299	<0.005
	6 cm, *B*, X, *D*	0.580	4.031	<0.005
	H, *B*, X, *D*	0.562	3.844	<0.005
6 cm, 12	*D*	0.565	4.046	<0.005
	H, *D*	0.393	2.492	0.009
	B, *D*	0.392	2.482	0.010
	X, *D*	0.404	2.578	0.008
	FIR, *D*	−0.138	−0.810	0.219
	H, *B*, *D*	0.396	2.477	0.010
	H, X, *D*	0.283	1.697	0.050
	H, FIR, *D*	−0.035	−0.204	>0.400
	B, X, *D*	0.310	1.874	0.037
	B, FIR, *D*	−0.074	−0.426	0.339
	X, FIR, *D*	−0.134	−0.776	0.227
	H, *B*, X, *D*	0.281	1.659	0.055
	H, *B*, FIR, *D*	−0.036	−0.204	>0.400
	H, X, FIR, *D*	−0.041	−0.233	>0.400
	B, X, FIR, *D*	−0.071	−0.404	0.347
6 cm, FIR	*D*	0.710	5.969	<0.005
	H, *D*	0.654	5.046	<0.005
	B, *D*	0.646	4.940	<0.005
	X, *D*	0.578	4.127	<0.005
	12, *D*	0.535	3.694	<0.005
	H, *B*, *D*	0.651	4.933	<0.005
	H, X, *D*	0.558	3.858	<0.005
	H, 12, *D*	0.570	3.983	<0.005
	B, X, *D*	0.564	3.926	<0.005
	B, 12, *D*	0.562	3.905	<0.005
	X, 12, *D*	0.467	3.031	<0.005
	H, *B*, X, *D*	0.557	3.799	<0.005
	H, *B*, 12, *D*	0.564	3.865	<0.005
	H, X, 12, *D*	0.502	3.283	<0.005
	B, X, 12, *D*	0.500	3.263	<0.005

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