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A survey of infrared features in H II regions, planetary nebulæ and proto-planetary nebulæ from the IRAS–LRS data base

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Abstract. — We report on a systematic investigation of infrared emission and absorption features in H II regions, planetary nebulæ and proto-planetary nebulæ from the IRAS-LRS data base. The resulting selection constitutes a new data base (containing 284 sources) which is complemented by all published lines in the range 2–20 μm. We provide information on atomic, molecular and solid state material. A preliminary analysis of this dataset is presented with a special emphasis on the PAH emission features.

Key words: Interstellar medium: dust – H II regions – reflection nebulæ – planetary nebulæ – infrared radiation

1. Introduction.

The IRAS-LRS (Low Resolution Spectra) data base contains a total of about 170,000 individual spectra corresponding to about 50,000 sources. These spectra cover the wavelength range 7.8 to 22.5 μm. A selection has been published in the LRS Atlas (IRAS Science Team, 1986) but many good quality spectra are only in the data base. We have systematically examined the individual spectra of known H II regions, planetary nebulæ (PN) and proto-planetary nebulæ (PPN) as well as spectra with emission lines or with a flat or rising continuum in the LRS Atlas. Additionally, many similar sources, not in the LRS Atlas but with good spectra in the LRS data base, have been included in our sample.

The resulting selection constitutes a new data base which, although being neither complete nor homogeneous, contains a very large amount of information. An extensive literature search has added to this base a number of objects with published emission lines in the infrared wavelength range 2–20 μm. Previous accounts on this project have been given in Jourdain de Muizon et al. (1989).

This work extends and generalizes previous work done by Pottasch and his collaborators (Pottasch et al., 1984, 1985; Pottasch et al., 1986a; Antonopoulou and Pottasch, 1987). These authors have studied a number of selected previously known LRS sources (planetary nebulæ and H II regions), and, for 87 of them, they measured emission lines from ionised gas and derived some abundances. In the present work, we have selected over three times more sources, and we present the qualitative content of their infrared spectrum, in term of gas emission lines as well as dust emission and absorption features. In particular, we present a statistics on PAH emission features which is totally new in this context.

The IRAS-LRS data and our working procedure are described in Section 2. In Section 3, a qualitative description of lines and features in the spectra of these sources is presented in a series of three catalogues corresponding to H II regions and reflection nebulæ, planetary and proto-planetary nebulæ, and miscellaneous sources, respectively. First results and a general discussion follows in Section 4.

2. LRS data and working procedure.

The IRAS satellite carried a Low Resolution Spectrometer (LRS) as part of its detection system. A detailed description of this instrument is given in Wildeman et al. (1983). Also, information about the LRS and data reduction is given in the IRAS Explanatory Supplement (1988). We only recall here a few characteristics relevant to the present work.

The LRS was a slitless spectrometer; therefore, it was well-suited to point sources whereas confusion arises in the case of extended sources. Two wavelength channels were

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recorded simultaneously: Band 1 (7.7 – 13.4 μm) and Band 2 (11.0 – 22.6 μm). The long wavelength channel consists of a single reflecting prism. For the short wavelength channel, a second similar prism was used in tandem with the first one in order to achieve a better dispersion. The wavelength resolution $\lambda/\Delta\lambda$ varies between 10 and 60; it increases with wavelength inside each wavelength band, the resolution being systematically somewhat lower in band 2 than in band 1. Also, the resolution varies with the angular extent of the source, and the wavelength scale may be somewhat displaced depending on the brightness distribution over the source. This is particularly crucial for extended sources.

Any point source observed by the survey instrument was also observed by the LRS. Only for those sources brighter than about 2 Jy at 12 and 25 μm were the spectra extracted from the data stream and included in the LRS database. The LRS Catalogue (IRAS Science Team, 1985) consists of a subset of the LRS database containing average spectra of about 10% among the brightest LRS sources. Most of the LRS sources have a stellar origin (blue spectrum). Only a few percent have a red spectrum and correspond to H II regions, planetary and proto-planetary nebulæ, reflection nebulæ, young embedded objects and a handful of galaxies.

We have selected *all* sources with a red spectrum contained in the LRS Atlas. For each of these sources, we subsequently examined all its individual spectra in the LRS database. This was done in order to check the quality of the data and to eliminate possible spikes which sometimes can be superimposed over real emission features (Muizon et al., 1988). Sources were classified according to a variety of criteria described in Section 4 and independently of any previous classification scheme. We have not retained sources having a LRS spectrum characteristic of OH/IR stars or related evolved stellar objects. We have also selected from the LRS database about one hundred sources not included in the LRS catalogue. This selection includes sources having a spectrum characteristic of an H II region and several known planetary nebulæ.

The final sample consists of 192 H II regions, reflection nebulæ and embedded objects, 83 planetary and proto-planetary nebulæ and 9 miscellaneous sources.

3. Catalogues of H II regions and reflection nebulæ, planetary and proto-planetary nebulæ.

The infrared spectral content of the sources selected with the criteria described in Section 2 is qualitatively presented in the form of catalogues in Tables I, II and III.

These catalogues give for each source:

- IRAS name
- IRAS coordinates of the source
- IRAS broad band fluxes in Jy
- A flag qualifying the presence of spectral lines and features in the LRS range. Although not in the LRS range, the presence of the 3.28 μm feature is indicated
- Associations with known sources, when applicable

For Catalogue I (H II regions and reflection nebulæ-in Table I) the identification of spectral lines and features is based essentially on the LRS spectra, and, for a few sources, on additional data from the literature. A * following the IRAS name means that the source is not in the LRS catalogue. A ** following the IRAS name means that the source is not in the Point Source Catalogue but is in the LRS database (this latter only occurs in two cases).

For Catalogue II (planetary and proto-planetary nebulæ–in Table II), the LRS spectra are in many cases of very poor quality (flux densities in Band 1 are low) and we have used mostly published data. Most sources are not in the LRS catalogue. NGC 7027 has been included (in italics) in our catalogue although not observed by IRAS; data for this source have been taken from the literature.

For Catalogue III (Miscellaneous–in Table III) we have listed some sources with IRAS fluxes typical of evolved stars but showing in their spectra either ionic lines or the PAH emission bands.

All references used outside the IRAS-LRS data are given, for each source, at the end of the Catalogues. Additional information, at other wavelengths, relevant to this study (e.g. H_2, CO, optical extinction etc..) is given in Table IV for the planetary and proto-planetary nebulæ. [1]

Meaning of the symbols used in the catalogues

For the IRAS broad band flux densities, the standard IRAS terminology has been kept, i.e. a flux density followed by : means a quality 2 (poor quality) and followed by L means a quality 1 (upper limit) which is in most cases meaningless for these sources due to confusion in the Galactic plane. All other values have quality 3 (good quality).

For the various spectral lines and features, we have adopted the following quality flags:

++ Feature is definitely present in emission and very strong

\+ Feature is definitely present in emission

? Possible detection

0 Feature is *not seen*

– Feature is definitely present in absorption

–– Feature is definitely present in absorption and very strong

.... Signal-to-noise in the spectrum is too low to be able to conclude anything

In the course of this work, we have given up our original idea to present quantitative results for the various line and band fluxes. Indeed it turned out that, for many sources including even some of the brightest LRS sources, such measurements would carry very high uncertainties. Measuring line fluxes on each individual LRS spectrum of a

[1] This extensive literature search was done with the program SIMBAD of the *Centre de Données Stellaires* (C.D.S) of Strasbourg, France

given source shows discrepancies up to a factor 3 (sometimes even worse) due to the fact that the LRS is a slitless spectrometer. Additionally, the problem of spikes described in Muizon et al. (1988) makes such measurements delicate to handle. Due to the extent of many sources, it is also difficult to link the LRS to ground-based or airborne observations and we have refrained doing so. Considerable care has to be taken to carry out any quantitative investigation of the LRS spectra. A detailed study of the source properties (and of its extent in particular) is necessary before any firm conclusions can be reached; this was clearly beyond the scope of this paper.

4. Results.

4.1 Spectral content. – Characteristic spectra for sources contained in the H II sample and planetary nebulæ sample are presented in Figures 1 and 2. These spectra were chosen for their good spectral quality and represent the different types or situations encountered in each category. In the following, we give brief comments on the individual spectra.

In the case of the H II regions and related objects listed in Table I, the infrared spectra show a variety of features depending on the excitation conditions but also on the geometry and the environment of the source. The features which can be seen in H II region are the atomic lines([Ar III], [S IV], [Ne II], [Ne III] and [S III]), the PAH features at 7.7, 8.6 and 11.3 μm and the silicate absorption features at 9.7 and 18 μm. The situation varies from pure atomic emission spectra to pure silicate absorption spectra.

We present successively in Figure 1:

i) Two highly excited H II regions (G291.858 and G298.228) with strong emission lines from ionized gas but without any clear dust features. In particular the lines of [S IV] 10.5 μm, [Ne II] 12.8 μm, [Ne III] 15.5 μm and [S III] 18.7 μm are prominent. Although intrinsically very strong, they do not stick out as clearly in G298.228 due to the very bright continuum in this source.

ii) Three moderately excited H II regions (S 159, S 156 and S 138), with strong emission lines of [Ne II] 12.8 μm and [S III] 18.7 μm and with strong PAH emission features at 7.7, 8.6 and 11.3 μm.

iii) Three reflection nebulæ, NGC 1333, Parsamyan 18 and IRAS 20319 + 3958; this latter could also be a very low excitation H II region. The only apparent features in these three spectra are the PAH emission bands. The absence of [Ne II] 12.8 μm line makes very clear the presence of an emission plateau between 11.5 and 13 μm, most likely also due to PAHs.

iv) Two H II regions (G328.310 and 329.353) with thicker dust shells causing silicate absorption at 10 and 18 μm, but not thick enough to prevent emission lines from [Ne II] 12.8 μm and [Ne III] 15.5 μm from passing through.

v) Finally, two deeply embedded compact H II regions (AFGL 2591 and S 140) showing pure absorption (silicate bands at 10 and 18 μm) but no sign of any emission feature.

For the planetary nebulæ, the features present in the infrared spectra depend mainly on the excitation conditions and on the chemical composition (carbon or oxygen-rich sources). The lines which can be seen are atomic lines ([Ne VI], [Ar III], [S IV], [Ne II], [Ne V], [Ne III] and [S III]), the silicate features in emission, the SiC emission feature at 11.5 μm and the series of PAH features.

At the top of Fig. 2 are displayed four spectra of evolved planetary nebulæ(NGC 6153, NGC 6369, NGC 6302 and NGC 6572) showing almost exclusively various strong emission lines from ionized gas, up to rather high degrees of ionization e.g. [Ne VI] 7.6 μm (only seen in NGC 6302; the peak of the line reaches in fact the value 4×10^{-16} W.cm^{-2}.μm^{-1}) but has been chopped for scaling reason), [Ar III] 9.0 μm, [S IV] 10.5 μm, [Ne II] 12.8 μm, [Ne V] 14.3 μm, [Ne III] 15.5 μm and [S III] 18.7 μm. NGC 6302 is the planetary nebula with the most extreme excitation conditions of our sample. It also exhibits weak PAH features (marginal in the LRS spectrum). NGC 6302 is a type I planetary nebulæ which has been consistently classified as oxygen-rich, see Zuckerman and Aller (1986). In particular, NGC 6302 shows OH maser emission (Paynes et al., 1988) which tends to confirm a low C/O ratio. However, the C/O value may be suspect in view of the very high range of ionizations which goes from [Ne II] to [Ne VI] and even to [Si VI] and [Si VII] at 1.96 and 2.48 μm, respectively (Ashley and Hyland, 1988). This source clearly deserves further studies.

In the middle part of the Fig. 2 are four younger PNs or PPNs showing much less – or no – emission lines from ionized gas, but strong dust (PAHs) emission features: BD+30° 3639 is a young C-rich PN with a WC9 star, IRAS 21282 + 5050 and He2–113 are respectively a PPN and a very young PN with WC10-11 central stars, and HR 4049 is a PPN.

Finally, at the bottom of the Fig. 2 are displayed the spectra of four PNs showing silicate features, although they may be at quite different stages of evolution. CRL 618 is a carbon-rich object (from chemistry) in a transition stage from PPN to PN (Bachiller et al., 1988), and showing rather surprisingly silicate emission. M1–26 and He2–131 are oxygen-rich PNs; the two silicate bands are present in emission in M1–26, but their presence is very doubtful in He2–131. The [Ne II] 12.8 μm line appears on both spectra. As for RAFGL 6815S, it is a newly discovered IRAS PN (or PPN).

4.2 Classification. – One of the aims of this study was to provide a series of criteria which could be used in identifying unknown sources having both infrared fluxes from the Point Source Catalogue and a spectrum in the LRS database.

It has been shown by many authors that the knowledge of *only* three good quality fluxes of the four IRAS fluxes and a combination of them is sufficient to make classifications. Sources of a given type occupy in the color-color diagrams distinct zones. This method has been successfully applied in the case of Seyfert galaxies (de Grijp et al., 1985), normal and starburst galaxies (Helou, 1989) and in the study of the late stages of stellar evolution (van der Veen and Habing, 1988; Volk and Kwok, 1988).

From the IRAS data, it is possible to build six colors, with only three independent colors. With these six colors it is possible to construct 15 pairs and hence 15 color-color diagrams. All possible color-color diagrams have been analysed and we present here the diagram which separates the H II region and planetary nebula samples in the best possible way.

In Figure 3, the diagram of the 100/25 μm versus 60/25 μm flux density ratios is shown for the sources in Tables I and II having good quality fluxes. The H II regions and planetary nebulæ form very distinct groups, whose frontiers are defined by a value of 2.5 for both the 100/25 μm and the 60/25 μm flux ratios.

The points are distributed along a sharply defined linear sequence. The deviation remains within a factor two along this strip. The 100/25 μm against 60/25 μm color-color diagram defines in fact a temperature sequence from hot to warm objects and indicates the variation of the strength of the radiation field within the sources. The straight line shown in Fig. 3 represents a modified black-body law $\nu B_\nu(T_d)$. Temperatures are given in Fig. 3. It may be noted that the colder the objects the more the points tend to lie above the black-body curve. This may be due to a behaviour typical of a separate small grain population and a more detailed discussion of this particular problem will be given elsewhere. Two or three sources are located outside their specific zones in the 100/25 μm against 60/25 μm color-color diagram and correspond to H II regions or planetary nebulæ with extreme conditions. IRAS 21190+5140 (known as M1-78) is an example of such an extreme source. For a long time classified as a planetary nebulæ, M1-78 has been recently shown to be an H II region (Puche et al., 1988 and Cox et al., 1990). It is the hottest H II region in the sample (the infrared spectrum peaks at 25 μm) and may well be the hottest known H II region.

With these few exceptions in mind, the color-color diagrams show that selection on color alone remains a very powerful tool to identify unknown sources from the Point Source Catalogue and, in particular, to distinguish between H II regions and planetary nebulæ. Further refinement on the identification can be gained by looking at the LRS spectra as described in Sect. 4.1 and illustrated in Figures 1 and 2.

4.3 PAH EMISSION FEATURES. – Infrared emission features at 3.3, 6.2, 7.7, 8.6 and 11.3 μm have been detected since 1973 and appear *together* in a variety of sources including H II regions, planetary nebulæ, reflection nebulæ and extragalactic regions (see reviews by Willner, 1984; Whittet, 1988). These features have been attributed to a family of molecules known as Polycyclic Aromatic Hydrocarbons or PAHs (Léger and Puget, 1984). PAHs are made of benzene rings linked to each other in a plane, with hydrogen atoms and perhaps other radicals attached to the outer bonds of the peripherical carbon atoms. For a recent account on the properties of these molecules, which may be regarded as the molecular domain of the size distribution of interstellar grains, see Puget and Léger (1989).

Usually, the observations with a single instrument do not cover the whole PAH spectrum and one must combine observations made in various ways, resulting in variable beams and signal-to-noise ratios for a single source. The LRS wavelength range includes the 7.7 μm feature (on the edge of the spectra), the 8.6 μm band which appears as a shoulder on the long-wavelength edge of the 7.7 μm feature and is unresolved from it, and the 11.3 μm feature. In addition, longward of the 11.3 μm emission feature a plateau of emission is often present, ending at about 13.0 μm. This plateau feature is a common characteristic in sources with a strong 11.3 μm (Jourdain de Muizon et al., 1990). Cohen, Tielens and Allamandola (1985) attributed this plateau to the CH out-of-plane bending mode of PAHs having different degrees of hydrogenation; the exact position of this bending mode depends on the number of hydrogen neighbours (Léger and Puget, 1984; Léger and d'Hendecourt,1987).

Despite their relatively low sensitivity and spectral resolution as compared to existing data taken from the ground (such as those of Aitken and Roche, 1986 and references therein), the LRS database has the advantage to present an unbiased sample of an unprecedented number of sources. Whereas many of the known planetary nebulæ had been observed previously (see areferences in Table II), the spectra of most of the H II regions contained in Table I were never observed before. Systematic studies, such as statistical analysis, are thus possible. Quantitative analysis, however, should wait for more sensitive and better quality data. The results of a statistical analysis on the PAH emission features contained in the LRS database are presented in Table V for H II regions, reflection nebulæ and embedded young stellar objects and in Table VI for planetary nebulæ and proto-planetary nebulæ.

From Tables V and VI, we can reach conclusions, concerning PAH emission features, which, although not really new (see e.g. Barlow, 1983, Cohen et al., 1986, Roche and Aitken, 1986, Zuckerman and Aller, 1986, Jourdain de Muizon et al., 1990), are based upon a substantially increased data base, especially for the 7.7 μm feature which cannot be observed from the ground.

In H II regions, reflection nebulæ and embedded young stellar objects PAH emission is *ubiquitous*. It obviously requires the presence of ultraviolet photons and is seen near essentially all H II regions. PAHs are presumably excited at the interface with the neutral gas as shown by a series of recent observations of the spatial distribution of the 3.3 and 11.3 μm features (Woodward et al., 1989, Roche et al., 1989, Sellgren et al., 1989). The few sources in Table I where PAH features are *not* seen have most often deep silicate absorption features at 9.7 μm (and 18 μm). In this case, the emission of PAHs – probably originating at the ionised/neutral gas interface – is completely absorbed by the surrounding dust. This explanation is strengthened by recent model calculations of the infrared spectra of embedded compact H II regions (Churchwell et al., 1990).

In planetary and proto-planetary nebulæ, PAH emission is seen only where an ionizing flux is present (for PNs) and/or in carbon-rich objects. Most objects with C/O $\gtrsim$ 1 show PAH emission, with the notable exception of CRL 618. Clearly, carbon-rich evolved stars are sites for the formation of PAHs (see theoretical predictions in Keller, 1987 and Frenklach and Feigelson, 1989). It is far from established, however, that all interstellar PAHs are produced in these sites.

4.4 ATOMIC LINES. – A detailed study on the atomic line content has been recently completed by Simpson and Rubin (1990).

5. Conclusion.

We have presented a systematic and extensive – although not completely exhaustive – qualitative and statistical study of gas emission lines and dust emission and absorption features in nearly three hundred IRAS-LRS planetary and proto-planetary nebulæ, as well as HII regions. In particular, we provide statistical results on the presence of PAH emission features in these sources. This compilation is aimed to be used as a database for preparing future observations with ISO (the Infrared Space Observatory, a European satellite to be launched in 1993), and especially with its two short and long wavelength spectrometers - SWS and LWS - which will operate respectively in the ranges 3–45 and 45–180 micron.

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Note added in proof:

As shown in a recent paper by d'Hendecourt and Jourdain de Muizon (1989, *Astron. Astrophys.* **223**, L5), the infrared spectrum of AFGL 890 (IRAS 06084-0611) showns in fact the silicate absorption features, the water ice libration mode at 13.6 um and the CO_2 bending mode at 15.2 um instead of the PAH emission features as stated in Table I.

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TABLE I. *H* II *regions, reflection nebulæ and embedded young stellar objects.*

IRAS NAME	POSITION (1950.0) α (h m s)	δ (° ′ ″)	Point Source Catalog Fluxes (Jy) 12 µm	25 µm	60 µm	100 µm	IONIC LINES ArIII (9.0µm)	SIV (10.5µm)	NeII (12.8µm)	NeIII (15.5µm)	SIII (18.7µm)	SIL. 10µm	18µm	PAHs 7.7µm	8.6µm	11.3µm	Plateau (12µm)	3.3µm	ASSOCIATION
01056+6251	01 05 36.9	62 51 20	7.4	19.5	209	327 :	0	0	+	0	0	0	0	+	+	++	?		S186
02044+6031	02 04 29.1	60 31 43	12.1	105.8	388	466	0	0	+	0	0	0	0	+	+	+	?		PK 132-0.1
02575+6017	02 57 35.6	60 17 22	19.9	211.8	768	1083	0	0	?	0	0	0	0	+	+	++	+		IC 1848
03035+5819	03 03 33.2	58 19 21	31.0	396.1	1056	1297	0	0	?	0	0	0	0	+	+	++	+	+	AFGL 437
03235+5808	03 23 33.1	58 08 56	3.2	69.9	207	347 :	0	0	?	0	0	0	0	0	0	0	0		AFGL 5095
03260+3111*	03 26 04.7	31 11 41	37.0	100.9	534	947	0	0	0	0	0	0	0	+	+	++	+	+	AFGL 5096
04000+5052	04 00 04.0	50 52 35	5.6	14.8	196	275	0	0	?	0	0	0	0	+	+	+	?		
04324+5106	04 32 28.7	51 06 39	12.5	131.6	649	645	0	0	+	0	0	0	0	+	+	+	?		AFGL 5124
04547+4753	04 54 44.7	47 53 54	10.4	82.0	360	367	0	0	+	0	0	0	0	+	+	+	+		S 217
05044-0325	05 04 25.8	- 03 25 08	13.1	38.6	232	382	0	0	0	0	0	0	0	+	+	+	+	+	CED 40
05305+3029	05 30 32.0	30 29 03	11.2	79.7	268	264	+	0	+	0	0	0	0	+	+	+	?		
05375+3540*	05 37 32.1	35 40 45	28.2	226.4	1709	1635	0	0	+	0	0	0	0	+	+	+	+	+	BFS46/S235B
05380-0728	05 38 02.7	- 07 28 59	28.2	89.6	187	227 :	0	0	0	0	0	-	?	?	?	?	?		AFGL 5163
05393-0156*	05 39 18.0	- 01 56 42	284.4	4746.3	7894 :	35331	?	0	+	0	0	0	0	+	+	+	?		NGC2024
06053-0622	06 05 20.4	- 06 22 31	469.6	4095.2	13068	20194	0	0	+	0	0	-	-	?	?	?	0		MonR2
06061+2151	06 06 07.3	21 51 12	12.0	144.8	896	1130	0	0	+	0	0	0	0	+	+	+	?		AFGL 5182
06073+1249	06 07 23.5	12 49 24	10.3	131.3	543	510	0	0	?	0	0	0	0	+	+	+	?		S 270
06084-0611	06 08 24.5	- 06 11 12	27.1	603.5	3613	4876	0	0	0	0	0	0	0	+	+	?	?		AFGL 890
06099+1800*	06 09 57.9	18 00 12	107.2	371.6	3145	5285	0	0	+	0	0	-	-	0	0	0	0		AFGL 896/S255
06104+1524	06 10 29.2	15 24 49	3.6	34.1	252	444 :	0	0	0	0	0	0	0	+	+	+	+		AFGL 5186
06114+1745	06 11 28.6	17 45 33	13.3	55.2	545	705	0	0	0	0	0	0	0	+	+	+	+		AFGL 5188
06299+1011	06 29 55.7	10 11 50	9.1	9.3	106	315	0	0	0	0	0	0	0	+	?	+	?		AFGL5198/CED80
06303+1021	06 30 18.6	10 21 39	12.5	20.2	109	159 :	0	0	0	0	0	0	0	+	+	+	?	+	CED81
06308+0402	06 30 52.7	04 02 27	13.4	38.3	603	949	0	0	+	0	0	0	0	+	+	+	+		
06319+0415	06 31 59.0	04 15 09	78.4	375.2	959	995	0	0	0	0	0	-	?	0	0	0	0		AFGL961
06412-0105	06 41 12.5	- 01 05 02	13.9	159.1	612	533	0	0	0	0	0	0	0	+	+	++	+		
06572-0742	06 57 16.8	- 07 42 16	18.2	141.4	419	474	0	0	0	0	0	0	0	+	+	+	+	+	BFS62/P18
07017-1114	07 01 47.1	- 11 14 29	11.8	35.1	259	470 L	0	0	0	0	0	0	0	+	+	+	+		AFGL 5220
07358-3243	07 35 51.9	- 32 43 29	6.4	50.7	207	262	?	0	?	0	0	0	0	+	+	+	?		
08189-3602	08 18 54.1	- 36 02 60	53.5	361.3	1783	2059	+	+	+	+	+	0	0	+	+	+	?		G254.676
08247-4223	08 24 43.1	- 42 23 10	7.5	21.9	238	412	0	0	0	0	0	0	0	+	+	+	?		
08375-4109	08 37 31.8	- 41 09 14	7.3	55.7	178	276 :	0	0	0	0	0	0	0	+	+	+	+		
08438-4340	08 43 50.2	- 43 40 02	13.4	56.0	638	1576	0	0	0	0	0	0	0	+	+	++	+		
08470-4243	08 47 00.0	- 42 43 12	14.6	97.1	952	1814	0	0	0	0	0	0	0	+	+	++	+		
08485-4419	08 48 35.3	- 44 19 26	14.6	196.5	867	1002 :	?	0	+	0	0	0	0	+	+	+	?		
08513-4201	08 51 19.2	- 42 01 39	12.4	135.5	455	618	0	0	0	0	0	0	0	+	+	+	+	+	
08546-4254*	08 54 39.0	- 42 54 11	29.3	193.6	1344	2098 :	?	0	+	0	+	0	0	+	+	+	?		G264.292
09002-4732	09 00 12.1	- 47 32 07	120.5	1962.0	11877	14707	0	0	+	0	0	0	0	+	+	+	+		G268.454
09014-4736	09 01 27.5	- 47 36 32	30.3	79.6	621	957	0	0	0	0	0	0	0	+	+	+	?		
09017-4716	09 01 42.3	- 47 16 26	17.7	87.9	333	493 :	0	0	0	0	0	?	?	0	0	0	0		
09563-5743	09 56 23.1	- 57 43 25	10.9	177.1	870	1283	0	0	+	0	0	0	0	+	+	+	+		G281.556
09578-5649	09 57 49.3	- 56 49 20	17.9	82.3	920	1724	0	0	?	0	0	0	0	+	+	+	+		G281.162
10019-5712	10 01 57.6	- 57 12 05	9.6	69.1	437	742	0	0	?	0	0	0	0	+	+	?	?		
10031-5632	10 03 11.6	- 56 32 01	16.8	208.5	1166	1512	0	0	+	0	?	0	0	+	+	+	+		G281.595
10105-5719	10 10 33.5	- 57 19 16	7.7	24.1	214	402 L	0	0	0	0	0	0	0	+	+	+	+		
10123-5727	10 12 22.3	- 57 27 16	8.5	27.0 :	794	1985	0	0	0	0	0	0	0	?	?	?	?		G283.131
10277-5730	10 27 42.6	- 57 30 10	7.2	21.6	270	574	0	0	0	0	0	0	0	?	?	?	?		
10286-5838	10 28 40.2	- 58 38 04	4.6	91.0	391	696	0	0	0	0	0	0	0	+	+	?	?		
10308-6122	10 30 52.3	- 61 22 04	7.7	15.1	268	656	0	0	0	0	0	0	0	?	?	?	....		
10320-5928	10 32 04.9	- 59 28 24	22.9	223.0	911	1509	0	0	+	0	0	0	0	+	+	+	?		G286.401
10460-5811	10 46 04.6	- 58 11 07	15.7	108.4	391	380 :	0	0	?	0	0	0	0	+	+	+	?		
10589-6034*	10 58 56.9	- 60 34 19	36.9	313.3	1718	2109	?	0	+	0	+	0	0	+	+	+	+		AFGL4122/G289.878
10591-5934	10 59 11.6	- 59 34 52	20.0:	41.8	743	1314	0	0	0	0	0	0	0	+	+	+	?		G289.520
11066-7722	11 06 37.0	- 77 22 46	14.5	40.3	70	250 L	0	0	0	0	0	0	0	?	?	+	0		HD97048/CED111
11097-6102*	11 09 44.7	- 61 02 17	391.0	5957 :	10904	38552 L	0	0	+	0	0	0	0	0	0	0	0		AFGL4124/G291.284
11143-6113	11 14 23.7	- 61 13 36	24.9	197.3	683	1389 L	0	++	+	+	+	0	0	0	0	0	0		AFGL4127/G291.858
11332-6258	11 33 12.9	- 62 58 15	6.9	37.4	479	1163 L	0	0	0	0	0	0	0	+	+	+	?		G294.5-01.6
11354-6154	11 35 27.5	- 61 54 09	11.6	52.0	580	893 :	0	0	0	0	0	0	0	+	+	+	+		
11431-6516	11 43 10.2	- 65 16 19	11.9	47.6	389	595	0	0	?	0	0	0	0	+	+	++	+		
12063-6259	12 06 23.0	- 62 59 14	50.1	407.4	1824	2233	+	+	+	+	+	0	0	+	+	++	++	+	He2-77/AFGL4144
12073-6233	12 07 21.7	- 62 33 15	577.4:	4084.3	10672	11345	0	+	+	+	+	0	0	0	0	0	0		G298.228

TABLE I. *(continued)*

IRAS NAME	POSITION (1950.0)		Point Source Catalog Fluxes (Jy)				IONIC LINES					SIL.		PAHs					ASSOCIATION
	α (h m s)	δ (° ' ")	12 µm	25 µm	60 µm	100 µm	ArIII (9.0µm)	SIV (10.5µm)	NeII (12.8µm)	NeIII (15.5µm)	SIII (18.7µm)	10µm	18µm	7.7µm	8.6µm	11.3µm	Plateau (12µm)	3.3µm	
12331 -6134	12 33 09.5	- 61 34 34	49.0	230.1	1646	2589	0	0	+	+	+	0	0	+	+	?	0		G301.108
12389 -6147	12 38 57.6	- 61 47 41	51.0	161.9	621	990	0	0	0	0	0	0	0	+	+	+	+	+	
12405 -6238	12 40 34.5	- 62 38 46	10.5	211.5	1055	1588	0	0	+	0	0	0	0	?	?	?	?		G302.025
12437 -6218	12 43 44.5	- 62 18 54	7.9	67.2	408	680	0	0	+	0	0	0	0	+	+	+	?		
13291 -6249	13 29 06.2	- 62 49 54	22.5	226.2	1170	1913 :	?	0	++	0	+	0	0	+	+	+	?		G307.569
13291 -6229*	13 29 08.8	- 62 29 51	32.9	249.1	1523	3479	0	0	+	0	0	0	0	+	+	+	+		G307.620
13338 -6312	13 33 53.3	- 63 12 57	4.6	72.9	326	316	0	0	?	0	0	0	0	+	?	?	?		
13395 -6153*	13 39 32.0	- 61 53 37	250.7	601.6	2701	3566	0	0	0	0	0	-	-	0	0	0	0		AFGL4176
13471 -6120*	13 47 11.3	- 61 20 19	76.3	667.9	3930	4473 L	0	0	0	0	0	-	-	0	0	0	0		OH309.8+0.5
14039 -6113	14 03 57.8	- 61 13 04	49.9	293.3	2710	5102	0	0	+	0	0	-	-	?	?	?	0		AFGL4190/G311.894
14050 -6056*	14 05 05.2	- 60 56 29	30.7	314.1	1815	2879	0	0	+	0	0	0	0	?	?	?	?		G312.112
14159 -6038	14 15 54.3	- 60 38 06	9.0	103.6 :	882	1982 L	0	0	+	0	0	?	?	?	?	+	+		G313.446
14382 -6017	14 38 12.8	- 60 17 37	25.0	186.1	1468	2453	?	0	+	0	+	?	?	+	+	+	?		G316.155
14394 -6004	14 39 26.3	- 60 04 33	10.1	42.5	751	1468	0	0	?	0	0	-	?	?	?	?	?		G316.393
14453 -5912*	14 45 18.3	- 59 12 25	26.1	153.9	1239	2450	0	0	+	0	+	0	0	+	+	?	?		G317.396
14567 -5846	14 56 45.1	- 58 46 23	33.8	300.8	2075 L	4199 L	0	0	+	+	?	-	-	?	?	?	?		G318.911
14594 -5824*	14 59 24.5	- 58 24 23	39.6	282.1	3273	4886	0	0	+	0	0	0	0	+	+	+	?		G319.380
15062 -5622	15 06 15.6	- 56 22 56	7.5	11.5 L	433	1141	0	0	?	0	0	0	0	+	+	?	?		
15100 -5613	15 10 01.2	- 56 13 42	10.2	168.5	1415	3275	0	0	+	0	0	0	0	+	+	+	?		G321.710
15100 -5903*	15 10 03.1	- 59 03 58	11.0	12.9	227	547	?	0	?	0	0	0	0	+	+	+	?		RCW89
*15147 -5627***	15 14 47.2	- 56 27 41	*192*	*868*	*13464*	*26477*	0	0	+	0	0	0	0	+	+	?	?		RCW92
15163-5525	15 16 18.8	- 55 25 18	9.0	30.2	266 L	1013 L	0	0	0	0	0	0	0	+	+	+	?		
15246 -5612	15 24 40.3	- 56 12 38	14.6	53.1	536	1073	0	0	0	0	0	0	0	+	+	+	+		G323.440
15254 -5621	15 25 26.6	- 56 21 04	84.1	522.4	3011	4098	0	0	+	0	0	-	-	0	0	0	0		G323.470
15278 -5620	15 27 49.8	- 56 20 15	23.6	166.7	1960	3259	0	0	?	0	0	0	0	+	+	+	+		
15290 -5546	15 29 01.2	- 55 46 06	47.5	502.3	4822	6971	?	0	++	?	+	0	0	+	+	?	0		G324.192
15384 -5348*	15 38 28.3	- 53 48 59	94.5	608.3	5819	8426	0	0	++	?	+	0	0	+	+	?	+		G326.441
15408 -5356*	15 40 53.0	- 53 56 31	162.8:	1678.0	10461	16762	0	0	++	+	+	0	0	+	+	?	+		G326.644
15492 -5426*	15 49 13.3	- 54 26 22	374.8:	3094.6	33	L30947	0	0	+	?	?	0	0	+	+	?	0		G327.313
15502 -5302	15 50 16.7	- 53 02 47	142.4	1209.6	11566	12622	0	0	+	0	0	-	-	?	?	?	?		G328.310
15530 -5231	15 53 01.2	- 52 31 46	18.2	134.9	1154	2078	0	0	+	0	0	0	0	+	+	+	+		G328.935
15544 -5159	15 54 29.2	- 51 59 10	11.4	83.2	516	943	0	0	+	0	0	0	0	+	+	+	+		
15557 -5337*	15 55 46.1	- 53 37 02	248.1L	815.3 :	11173	15903	0	0	+	0	0	0	0	+	+	?	?		G328.593/PK328-0.1
15567 -5236	15 56 43.5	- 52 36 19	195.8	1076.6	7398	8360	0	0	++	0	0	-	-	?	?	?	?		G329.353
15584 -5247	15 58 28.6	- 52 47 06	15.9	73.7	570	1112	0	0	+	0	0	0	0	+	+	+	?		
15596 -5301	15 59 40.1	- 53 01 14	4.8	51.6	1102	2487	0	0	0	0	0	0	0	+	?	?	?		
16026 -5035*	16 02 39.6	- 50 35 22	52.2:	254.6	2446	4356	0	0	+	0	0	0	0	+	+	+	+		G331.354
16083 -5154*	16 08 22.1	- 51 54 49	45.7:	228.3 :	2057	3502	0	0	+	0	0	0	0	+	+	+	?		G331.108/G331.115
16128 -5109*	16 12 51.0	- 51 09 34	128.9	1075.1	6234	8651	0	0	+	+	+	0	0	+	+	?	?		G332.148/PK332-0.1
16132 -5039*	16 13 14.8	- 50 39 46	44.8:	266.1	2311	4618	0	0	+	0	0	0	0	+	+	?	?		G332.541
16156 -5002*	16 15 38.0	- 50 02 04	44.7	191.2	2246	3691	0	0	+	0	0	0	0	+	+	+	?		G333.245
16164 -4929	16 16 25.2	- 49 29 04	22.9	181.1	1207	1981 :	0	0	?	0	0	0	0	+	+	+	?		G333.724
16177 -5018*	16 17 43.9	- 50 18 00	181.2	2054.1	7964 :	25627	0	0	+	0	0	0	0	?	?	?	?		G333.292
16183 -4958	16 18 22.9	- 49 58 57	2546	6809.2	5149	L36389	0	0	++	0	0	0	0	0	0	?	?		G333.610
16251 -4929	16 25 11.7	- 49 29 50	10.5	79.3	520	711	0	0	?	+	+	0	0	?	?	?	?		G334.714
16313 -4840	16 31 23.4	- 48 40 06	23.9	167.3	1029	2219	0	0	+	0	0	0	0	+	+	+	?		
16362 -4845	16 36 14.8	- 48 45 54	208.3	2977.7	12220	L18724	0	0	+	0	+	0	0	+	+	+	+	+	G336.514/RCW108
16396 -4429	16 39 40.3	- 44 29 42	21.6	203.9	1034	1585	0	0	+	0	0	0	0	+	+	+	+	+	
16555 -4237*	16 55 33.3	- 42 37 33	94.9	251.9	1918	2213	0	0	+	....	....	0	....	+	+	++	+	?	CD-42°11721
16571 -4029*	16 57 06.6	- 40 29 07	122.3:	974.6	9385 :	12724	0	0	+	0	0	0	0	+	+	+	?		G345.231
16586 -4142	16 58 38.0	- 41 42 32	90.8	651.4	3495	5238	0	0	++	?	+	?	0	?	?	?	?		G344.439
17006 -4215*	17 00 40.0	- 42 15 44	29.9L	262.8	2250	4530 :	0	0	++	0	0	0	0	+	?	+	?		G344.226
17074 -4549	17 07 25.1	- 45 49 10	12.8	305.3	1169	1909	0	0	?	0	0	0	0	+	+	?	?		
17136 -3617*	17 13 40.1	- 36 17 55	247.0	2504.7	10930	13622	0	0	+	0	0	0	0	?	?	?	?		G350.524
17160 -3707*	17 16 02.6	- 37 07 51	45.1:	335.5	4246	10440	0	0	++	0	0	?	0	?	?	?	?		G350.129
17178 -3742*	17 17 48.6	- 37 42 22	58.3:	329.1	3191 :	6880 L	0	0	+	0	0	0	0	?	?	?	?		G349.840
17184 -3638*	17 81 28.6	- 36 38 23	22.2	200.9	1191	1725 :	0	0	+	?	0	0	0	?	?	?	0		G350.813
17199 -3446	17 19 54.6	- 34 46 04	13.6	127.5	1311	2548	0	0	+	0	0	0	0	++	+	+	+	+	
17200 -3550*	17 20 01.6	- 35 50 56	137.6:	930.0	7204	L11936 L	0	0	++	0	0	0	0	+	+	?	?		G351.617
17221 -3619*	17 22 09.4	- 36 19 16	42.4	244.8 :	2644	4669 :	0	0	+	0	?	-	-	?	?	?	?		G351.467
17242 -3513	17 24 12.2	- 35 13 37	48.6:	198.5 :	1767	3630	0	0	?	0	0	-	-	0	0	0	0		G352.611

1990A&AS...83..337J

TABLE I. *(continued)*

IRAS NAME	POSITION (1950.0)		Point Source Catalog Fluxes (Jy)				IONIC LINES					SIL.		PAHs					ASSOCIATION
	α (h m s)	δ (° ′ ″)	12 µm	25 µm	60 µm	100 µm	ArIII (9.0µm)	SIV (10.5µm)	NeII (12.8µm)	NeIII (15.5µm)	SIII (18.7µm)	10µm	18µm	7.7µm	8.6µm	11.3µm	Plateau (12 µm)	3.3µm	
17271-3439*	17 27 09.3	-34 39 24	69.0	589.7	7040	12166	0	0	+	0	+	0	0	+	+	+	+		AFGL5345/G353.430
17279-3350*	17 27 59.8	-33 50 38	25.2	166.6 :	1237 :	3899	0	0	+	0	0	0	0	+	+	+	?		AFGL5347/G354.199
17355-3241	17 35 34.0	-32 41 55	15.4	28.6	186 :	418 :	0	0	0	0	0	0	0	+	+	+	?		
17439-2845*	17 43 58.2	-28 45 15	34.0	284.2	2050	7136 L	0	0	++	?	+	0	0	+	?	+	?	+	S20/PK 0-0.1
17455-2800*	17 45 32.3	-28 00 43	82.8	468.6	2543	5393	0	0	+	0	0	0	0	+	+	+	?		G1.141
17545-2357	17 54 30.0	-23 57 58	11.5	106.6	794	1667	0	0	++	0	0	-	-	?	?	?	?		G5.632
17574-2403*	17 57 28.5	-24 03 59	198.5	2190	12793	26785	0	0	+	0	0	0	0	+	+	+	?		AFGL2046/G5.897
17577-2320	17 57 46.9	-23 20 19	26.5	149.1	1446	2904	0	0	+	0	0	0	0	+	+	+	?		AFGL5428/G6.573
18006-2422*	18 00 41.5	-24 22 52	167.7:	1841.6	7755	9036	0	0	+	0	0	0	0	+	+	++	+		AFGL2052/G5.974
18032-2032	18 03 14.7	-20 32 08	38.6	292.4	4106	7844	0	0	+	0	0	0	0	+	+	+	?		G9.617
18092-1742	18 09 16.8	-17 42 48	15.1	60.8	953 :	2077 :	0	0	0	0	0	0	0	?	?	?	?		S40/G12.754
18110-1854	18 11 03.7	-18 54 18	13.6	222.1	2082 :	4930	0	0	+	0	0	0	0	+	+	+	?		AFGL5456/G11.936
18116-1646*	18 11 41.4	-16 46 19	75.0	478.1	3632	6041 L	0	0	+	?	+	0	0	+	+	+	+		G13.886
18162-2048	18 16 12.8	-20 48 51	25.7	346.7	2771	3709	0	0	?	0	0	0	0	+	+	+	+		AFGL2121
18162-1612	18 16 14.4	-16 12 38	9.7:	29.4	360	611	0	0	+	0	0	0	0	+	+	+	?	+	
18239-1228*	18 23 58.5	-12 28 23	39.5	244.9	2353	6784 :	0	0	+	0	0	0	0	+	+	+	?		G19.066
18295-1030	18 29 30.2	-10 30 50	16.9	105.1	1050	1399	+	0	+	0	0	0	0	++	+	+	?		AFGL5499/G21.442
18311-0809	18 31 10.4	-08 09 48	27.1:	184.2	1561	2904	0	0	++	0	0	-	-	?	?	?	?		AFGL5505/G23.693
18314-0720*	18 31 26.8	-07 20 29	156.3	648.2	4714	8089	0	0	+	0	+	-	-	?	?	?	?		G24.487
18316-0602	18 31 39.0	-06 02 08	22.7	137.6	958	2136	0	0	0	0	0	-	-	0	0	0	0		AFGL7009S
18317-0757	18 31 42.0	-07 57 12	66.3	394.8 :	2283 :	3339 :	0	0	++	0	+	0	0	+	+	+	?		AFGL2194/G23.957
18355-0532	18 35 35.9	-05 32 17	24.6	209.0	1127	1930 :	0	0	+	0	?	0	0	0	0	0	....		AFGL2211/G26.532
18406-0338*	18 40 39.6	-03 38 48	27.7	151.9	1247	3132 L	0	0	+	0	?	-	-	?	?	?	?		G28.817
18416-0420*	18 41 39.8	-04 20 60	91.3	821.0	3374	4358	0	0	+	0	+	0	0	+	+	+	+	+	AFGL2243/G28.295
18434-0242*	18 43 27.2	-02 42 35	217.5	1697.0	7501	11669 :	0	0	+	?	+	0	0	0	0	?	?		AFGL2245/G29.947
18462-0133	18 46 15.3	-01 33 18	16.4L	18.9 :	285	1516 L	0	0	+	0	0	0	0	+	+	+	?		
18479-0005	18 47 57.0	-00 05 33	31.7	298.0	3704	5473	0	0	++	0	0	-	-	?	?	+	?		AFGL5536/G32.797
18502+0051*	18 50 17.5	00 51 45	29.2	250.4	1456	2429	0	0	++	0	+	0	0	+	+	?	?		AFGL5541/G33.914
18507+0110*	18 50 47.0	01 10 49	140.2:	1106.1	11495	32457	0	0	+	0	0	-	-	0	0	0	0		AFGL2271/G34.254
18536+0753*	18 53 39.0	07 53 28	32.0	420.7	2058	4218 L	0	0	+	0	0	-	-	?	?	+	?		
18592+0108*	18 59 14.5	01 08 46	114.5:	1022.6	10151	13956	0	0	+	0	0	?	?	?	?	?	?		AFGL2304/G35.191
19095+0930	19 09 30.2	09 30 42	5.3	129.1	1725	2744	0	0	?	0	0	?	?	?	?	?	?		G43.784
19097+0847	19 09 46.3	08 47 09	18.9	95.9	774	1449	0	0	+	0	?	0	0	+	+	+	+	+	G43.182
19111+1048	19 11 06.2	10 48 23	250.0	1394.8	5913	7497	0	0	+	0	0	0	0	?	?	++	+		G45.125
19120+0917	19 12 03.1	09 17 18	13.9	145.4	741	1511	?	0	+	0	0	0	0	+	+	?	?		G43.890
19193+1504	19 19 21.9	15 04 12	7.8	27.6	337	652	0	0	+	0	0	0	0	+	+	+	?		G49.831
19205+1403*	19 20 35.4	14 03 20	22.8	105.5	1941 L	1661 L	0	0	++	0	+	0	0	+	+	+	?		G49.076
19207+1410	19 20 44.6	14 10 50	93.1	522.7	4932	7450	0	0	+	+	+	0	0	+	+	?	?		AFGL2379/G49.204
19213+1723	19 21 22.9	17 23 06	17.3	93.8	509	645	?	0	+	0	+	0	0	+	+	+	?	+	
19252+1737	19 25 17.3	17 37 16	4.5:	31.6	262	402	0	0	+	0	0	0	0	?	?	+	?		G52.753
19343+2026	19 34 19.3	20 26 23	17.0L	24.0	410	810	0	0	0	0	0	0	0	+	+	+	+		
19410+2336	19 41 04.2	23 36 54	14.4:	108.8	983	1631	0	0	?	0	0	0	0	+	+	+	+		
19442+2427*	19 44 13.5	24 27 60	47.4	425.5	3447	5174	0	0	0	0	0	0	0	+	+	+	+	+	AFGL2454/S87
19446+2505*	19 44 41.4	25 05 17	93.2:	1185.4	8686	13214	0	0	+	0	0	0	0	+	+	+	+		AFGL2455/S88B
19592+3302	19 59 13.8	33 02 47	29.6:	156.2 :	1185	1793	0	0	?	0	0	?	?	0	0	0	0		AFGL2492
19598+3324	19 59 50.0	33 24 20	302.3	1780.4	10590	12981	0	0	+	0	0	-	-	0	0	0	0		K3-50
20024+3330	20 02 26.8	33 30 25	33.3	94.8	258	260 :	0	0	0	0	0	0	0	+	+	++	?	+	G70.7+1.2
20068+3328	20 06 53.6	33 28 38	10.6	111.0	441	540	0	0	+	0	0	0	0	+	+	+	?		
20198+3716*	20 19 49.1	37 16 16	73.8	480.5	5445	6985 L	0	0	+	?	+	0	0	+	+	+	?		MWC1015
20220+3728	20 22 03.6	37 28 25	11.1	126.8	947	2131	0	0	?	0	0	0	0	?	?	?	?		
20255+3712	20 25 33.6	37 12 50	204.5	2509.9	10136	13132	0	0	+	0	?	0	0	+	+	+	+	+	AFGL2584/S106
20275+4001	20 27 35.2	40 01 09	438.9:	1111.8	5314	5721	0	0	0	0	0	- -	- -	0	0	0	....		AFGL2591
20286+4105	20 28 40.6	41 05 39	12.9	91.9	790	1387	0	0	0	0	0	0	0	+	+	+	+		
20293+3952*	20 29 21.3	39 52 59	25.6	180.2	643	916 :	0	0	+	0	0	0	0	+	+	+	?	+	
20319+3958	20 31 59.7	39 58 25	26.6	160.3	851	1054 :	0	0	0	0	0	0	0	+	+	++	+	+	
*20375+4109***	20 37 36.8	41 09 20	*68*	*1314*	*5485*	*7126*	?	0	++	0	?	0	0	+	+	+	+	+	DR22
21190+5140	21 19 05.7	51 40 39	39.2	377.5	590	408	0	0	+	0	+	0	0	?	0	+	0		M1-78
21334+5039	21 33 24.0	50 39 43	5.2	54.8	373	443	0	0	0	0	0	-	?	0	0	0	0		K3-83
22176+6303	22 17 41.1	63 03 41	308.3	1540.3	11232	13463	0	0	0	0	0	-	-	0	0	0	0		AFGL2884/S140
22308+5812	22 30 52.9	58 12 53	25.1	175.3	874	1038	?	0	+	0	+	0	0	+	+	+	+	+	S138

TABLE I. *(continued)*

IRAS NAME	POSITION (1950.0) α(h m s)	δ(° ' ")	Point Source Catalog Fluxes (Jy) 12 μm	25 μm	60 μm	100 μm	IONIC LINES ArIII (9.0μm)	SIV (10.5μm)	NeII (12.8μm)	NeIII (15.5μm)	SIII (18.7μm)	SIL. 10μm	SIL. 18μm	PAHs 7.7μm	8.6μm	11.3μm	Plateau (12 μm)	3.3μm	ASSOCIATION
22331+5809	22 33 06.5	58 09 09	4.1	36.2	92	107 :	0	0	?	0	0	0	0	?	?	?	?		S139
22475+5939*	22 47 30.9	59 39 03	25.0	150.7	832	1066	0	0	+	+	+	0	0	+	+	+	+		S146
22539+5758	22 53 56.3	57 58 44	6.8	61.1	319	401	0	0	?	0	0	0	0	+	+	+	?		
22566+5830	22 56 37.0	58 30 52	23.8	110.5	1186	2228	0	0	+	0	+	0	0	?	?	?	?		S152
23030+5958*	23 03 04.9	59 58 28	40.3	258.9	1550	1833	0	0	++	?	++	0	0	+	+	+	+	+	S156
23133+6050	23 13 21.5	60 50 47	44.9	581.5	2112	2694	0	0	+	0	+	0	0	+	+	+	?		S159
23138+5945*	23 13 53.5	59 45 37	28.7	232.8	1766	2164	0	0	0	0	0	0	0	+	+	+	+		S157/AFGL305
23151+5912*	23 15 08.7	59 12 25	50.8	203.3	1115	1009	0	0	0	0	0	-	-	0	0	0	0		
23185+6055	23 18 30.6	60 55 24	28.5	182.2	433	313	0	0	?	0	0	0	0	0	0	0	0		S162
23507+6230	23 50 43.7	62 30 19	9.3	15.5	175	406	0	0	?	0	0	0	0	+	+	+	?		

TABLE II. *Planetary nebulæ and proto-planetary nebulæ.*

IRAS NAME	POSITION (1950.0) α(h m s)	δ(° ' ")	Point Source Catalog Fluxes (Jy) 12 μm	25 μm	60 μm	100 μm	IONIC LINES NeVI (7.6μm)	ArIII (9.0μm)	SIV (10.5μm)	NeII (12.8μm)	NeV (14.3μm)	NeIII (15.5μm)	SIII (18.7μm)	SIL. 10 μm	SIL. 18 μm	SIC 11.5 μm	PAHs 7.7μm	8.6μm	11.3μm	Plateau (12 μm)	3.3μm	ASSOCIATIO
00102+7214	00 10 16.8	72 14 37	14.5	71.9	65	28 :	0	0	0	+	0	0	0	0	0	0	?	?	?	....		NGC 40
01539+6304*	01 53 57.8	63 04 39	0.7	3.7	8	4 L	....	....	?	....	....	....	....	....	....	....	....	....	....	....		IC1747
04215+6000*	04 21 30.6	60 00 22	4.2	9.5	4	2:	0	0	0	+	....	....	....	0	0	0	?	+	+	....		M4-18
04395+3601	04 39 34.1	36 01 15	470.8	1106.3	1036	340	0	0	0	0	0	0	0	+	+	0	0	0	0	....	?	CRL 618
05251-1244	05 25 09.5	- 12 44 18	38.3	199.2	104	31	0	+	0	++	0	?	?	0	0	+	+	?	?	....	+	IC 418
05526+4605*	05 52 40.3	46 05 52	2.2	17.2	14	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	?	IC 2149
06176-1036	06 17 37.7	- 10 36 53	421.6	456.1	173	66	0	0	0	?	0	0	0	0	0	0	+	+	++	+	+	CRL915
06194-1257*	06 19 24.3	- 12 57 44	1.3	9.6	7	2:	....	+	++	....	....	....	....	0	....	0	....	0	0	....		IC 2165
06230+1749*	06 23 02.0	17 49 14	2.2	9.8	8	3	....	0	+	0	....	....	....	....	....	0	+	?	+	....	+	J 900
06331-0003*	06 33 11.7	- 00 03 06	2.7	11.8	6	3 L	....	0	0	+	....	....	....	....	....	+	0	0	0	....		M1-6
07027-7934	07 02 45.3	- 79 34 23	22.7	82.0	42	14	0	0	0	0	0	0	0	0	0	0	+	+	+	....		
07090-1946*	07 09 05.9	- 19 46 01	12.9	63.5	32	8	0	0	0	+	0	0	0	0	0	++	+	+	+	....	+	M1-11
07172-2138*	07 17 12.8	- 21 38 19	2.2	12.4	6	11 L	....	0	0	+	....	....	....	....	....	+	....	0	0	....		M1-12
07262+2100*	07 26 13.2	21 00 56	0.9	9.0	20	16	....	0	0	0	....	....	....	....	....	0	....	0	0	....		NGC2392
07396-1805*	07 39 41.5	- 18 05 27	3.6	28.0	43	26 :	....	....	....	....	....	....	....	....	....	....	....	....	....	....	?	NGC2440
09105-4213*	09 10 34.1	- 42 13 15	0.8	10.4	10	9	....	0	+	0	....	....	....	....	....	....	....	....	....	....		NGC2792
09200-5805*	09 20 00.8	- 58 05 46	2.2	14.9	17	7	....	....	+	....	....	+	?	....	....	....	....	....	....	....		NGC2867
09373-5951*	09 37 20.7	- 59 51 55	4.1	27.1	19	6	0	+	+	+	....	++	?	0	0	?	....	....	?	....	+	IC 2501
10158-2844	10 15 50.1	- 28 44 32	48.3	9.6	2	2 L	0	0	0	0	0	0	0	0	0	0	+	?	+	0	+	HR4049
10162-6225*	10 16 12.6	- 62 25 10	0.6	6.6	6	9 L	....	?	++	....	....	....	....	....	....	....	....	....	....	....		NGC3211
10214-6017*	10 21 24.4	- 60 17 28	3.5	46.5	31	17 :	0	0	0	++	0	0	?	?	?	0	0	0	0	....	0	He2-47
10223-1823*	10 22 21.6	- 18 23 21	4.5	35.6 :	53	30	0	+	+	0	0	++	0	0	0	0	0	0	0	....	?	NGC3242
10583-6458*	10 58 23.8	- 64 58 48	6.6	32.0	24	13	0	+	+	0	0	+	0	0	0	?	+	?	+	....		IC2621
11478-5654*	11 47 48.4	- 56 54 12	6.8	60.9	54	20	0	+	++	+	+	+	0	0	0	0	....	....	....	....		NGC3918
12276-6435*	12 27 38.5	- 64 35 29	2.0	27.8	23	15 L	0		+	+	0	+	0	0	0	0	0	0	0	....		He2-86
13064-6103	13 06 26.9	- 61 03 40	49.4	83.8	20	50 L	0	0	0	+	0	0	0	+ -	?	0	0	0	0	....		He2-90
13359-6707*	13 35 55.5	- 67 07 41	1.8	20.7	24	13	....	+	+	+	....	?	0	0	0	....	....	....	....	....		MyCn18
13501-6616	13 50 11.1	- 66 16 05	7.5	71.9	84	36	0	+	+	+	0	++	+	0	0	0	....	....	+	....		NGC5315
14562-5406	14 56 15.1	- 54 06 16	92.4	310.5	177	71	0	0	0	+	0	0	0	-	?	+	+	+	+	?	+	He2-113
15022-5547	15 02 14.5	- 55 47 40	2.7	44.8	42	20 L	0	?	?	0	0	++	+	0	0	0	0	0	0	....		He2-117
15134-4527	15 13 25.5	- 45 27 60	3.0	34.2	49	23	0	+	++	0	0	++	+	0	0	0	0	0	0	....		NGC5822
15198-5658	15 19 50.2	- 56 58 50	16.7 L	70.9	35	238 L	0	0	0	0	0	0	0	+	+	0	0	0	0	....		Pe2-8
15318-7144	15 31 53.1	- 71 44 60	6.5	104.9	63	21	0	0	0	+	0	0	?	?	?	0	0	0	0	....		He2-131
15476-4836	15 47 38.5	- 48 36 01	19.5	38.6	17	10	0	0	0	0	0	0	0	0	0	0	?	?	?	....		Cn1-1
16133-5151	16 13 22.3	- 51 51 46	88.8	343.4	277	113	0	0	0	+	0	?	+	?	?	0	0	0	0	....		Mz3

TABLE II. *(continued)*

IRAS NAME	POSITION (1950.0) α (h m s)	δ (° ' ")	Point Source Catalog Fluxes (Jy) 12 µm	25 µm	60 µm	100 µm	IONIC LINES NeVI (7.6µm)	ArIII (9.0µm)	SIV (10.5µm)	NeII (12.8µm)	NeV (14.3µm)	NeIII (15.5µm)	SIII (18.7µm)	SIL. 10 µm	18 µm	SIC 11.5 µm	PAHs 7.7µm	8.6µm	11.3µm	Plateau (12 µm)	3.3µm	ASSOCIATION
16268-4556	16 26 48.4	- 45 56 22	6.5	49.5	48	266 L	0	0	0	+	0	0	0	0	0	0	....	....	?	....		Pe1-7
16280-4008	16 28 05.8	- 40 08 50	6.9	52.1	119	52	0	+	++	+	0	++	+	0	0	0	0	0	0	....		NGC6153
16423+2353*	16 42 23.4	23 53 27	2.1	25.9	35	15	0	+	++	0	0	++	0	0	0	0	0	0	0	....		NGC6210
16585-2145*	16 58 33.9	- 21 45 14	0.9	12.0	12	6	....	....	+	0	?	0	....	....	....	....	....	....	....	....		IC4634
17028-1004*	17 02 51.8	- 10 04 31	50.5	110.2	124	76	0	0	0	0	0	0	0	0	0	0	?	?	?	....		M2-9
17047-5650	17 04 47.5	- 56 50 58	143.7	257.2	199	92	0	0	0	+	0	0	0	0	0	0	++	?	+	+	+	CP-56°8032
17069-4149	17 06 54.4	- 41 49 07	3.3	25.8	59 :	33 :	0	0	?	?	0	+	0	0	0	0	0	0	0	....		H1-7
17103-3702	17 10 21.7	- 37 02 45	32.1	335.9	850	537	+	+	+	+	+	+	+	0	0	0	?	+	+	....		NGC6302
17112-1251*	17 11 15.2	- 12 51 13	1.4	17.4	24	15	0	+	+	0	0	?	0	0	0	0	0	0	0	....		NGC6309
17180-2708	17 18 04.0	- 27 08 42	2.4	20.3	32	20	0	?	++	0	+	+	?	0	0	0	0	0	0	....		M3-39
17262-2343	17 26 17.4	- 23 43 14	9.0	65.5	109	57	....	+	++	0	0	++	+	0	0	0	....	?	?	....		NGC6369
17388-2440*	17 38 49.0	- 24 40 44	1.3	10.3	21	13 L	0	+	++	?	0	+	0	0	0	0	....	0	0	....		HB4
17427-3010	17 42 45.1	- 30 10 57	14.4	177.9	60	256 L	....	?	0	++	0	0	0	+	+	0	0	0	0	....		M1-26
17447-2958*	17 44 43.8	- 29 58 41	11.7	79.2	134	312 L	?	+	+	+	+	+	0	0	0	0	?	?	+	....		HB5
17521-2144*	17 52 06.5	- 21 44 14	1.9	22.4	31	28 L	0	+	++	0	0	++	0	0	0	0	0	0	0	....		HB6
17534-1628	17 53 26.2	- 16 28 42	4.2	15.7	18	9 L	0	0	0	+	0	0	0	0	0	0	0	0	0	....		M1-32
17584+6638A	17 58 26.8	66 38 27	7.5	113.5	133	63	0	+	++	0	0	++	++	0	0	0	0	?	?	....	?	NGC6543
18021-1950	18 02 12.0	- 19 50 52	7.7	58.3	190	166	?	+	++	+	++	++	?	0	0	0	?	0	0	....		NGC6537
18096+0650	18 09 40.4	06 50 26	24.3	169.4	95	30	0	+	+	+	0	++	+	0	0	+	?	?	?	....	?	NGC6572
18129-3053	18 12 57.5	- 30 53 12	17.5	86.0	24	6	0	+	0	+	0	0	0	+	+	0	0	0	0	....		SwSt1
18132-2028*	18 13 17.5	- 20 28 09	12.5L	16.1	37	355 L	....	....	....	....	?	?	0	....	0	....	....	....	....	....		NGC6578
18152+1007*	18 15 12.4	10 07 52	0.8	14.4	10	5	....	0	0	+	....	....	....	....	....	0	....	0	0	....		Cn3-1
18226-2313*	18 22 40.6	- 23 13 58	2.6	34.0	37	23	....	....	....	....	0	+	0	....	....	....	....	....	....	....		NGC6629
18240-0244*	18 24 03.2	- 02 44 49	15.7	53.8	21	10 L	....	?	+	0	0	0	0	0	0	0	+	+	+	....		M2-43
18476+2047*	18 47 38.4	20 47 05	2.1	12.2	7	4 L	....	+	0	+	....	....	....	....	....	?	....	0	0	....		Hu2-1
18517+3257*	18 51 43.7	32 57 56	0.8	10.2	52	55	....	....	....	....	....	?	....	....	....	....	....	....	....	....		NGC6720
19000-0031*	19 00 02.3	- 00 31 23	1.6	12.5	20 L	96 L	0	+	++	+	?	+	0	....	....	0	....	?	+	....		NGC6741
19032-0604*	19 03 15.2	- 06 04 11	4.0	18.4	24	9 :	....	....	....	....	....	?	+	....	....	....	....	....	....	....		NGC6751
19204+0124*	19 20 24.8	01 24 56	13.8	34.9	13	3 :	0	+	+	0	0	+	0	0	0	++	?	?	+	....		NGC6790
19219+0947	19 21 59.1	09 47 58	15.5	94.2	43	10	0	0	0	+	0	0	0	+	+	0	0	0	0	....		Vy2-2
19289+0956*	19 28 54.3	09 56 57	0.8	10.6	12	4 :	....	+	++	+	....	?	....	....	....	....	....	....	....	....		NGC6803
19327+3024	19 32 47.2	30 24 18	89.4	234.5	162	70	0	+	0	+	0	0	+	0	0	0	+	+	+	+	+	BD+30°3639
19342+1935	19 34 14.5	19 35 35	4.3	32.9	21	58 L	....	....	....	....	0	++	0	0	0	....	....	....	....	....		M1-71
19434+5024*	19 43 27.9	50 24 11	4.9	39.3	47	21	....	....	+	+	0	++	0	0	0	0	?	?	?	....		NGC6826
20088+4618*	20 08 48.7	46 18 38	1.2	13.1	17	15 L	....	+	+	0	0	+	0	....	....	0	....	....	....	....		NGC6884
20090+3715*	20 09 01.8	37 15 45	2.8	19.3	20	67 L	....	0	+	0	....	....	....	....	....	0	....	....	?	....		NGC6881
20104+1950*	20 10 29.4	19 50 17	1.2	10.5	12	8	....	0	+	0	....	?	....	....	....	0	....	....	+	....		NGC6886
20119+2924*	20 11 55.5	29 24 44	4.5	37.7	39	12 :	....	0	0	+	0	0	0	0	0	0	....	....	+	+		He2-459
20179+1634*	20 17 51.4	16 34 21	2.5	26.8	10	3	....	+	+	0	0	0	0	+	+	0	....	0	0	....		IC4997
20590+5420*	20 59 04.9	54 20 49	1.5	24.5	44	35	....	++	?	....	....	....		....	....	....	....	....	....	....		NGC7008
21014-1133	21 01 27.4	- 11 33 48	6.3	56.7	90	48	0	+	++	0	0	+	+	0	0	0	0	0	0	....		NGC7009
21046+4739	21 04 36.0	47 39 02	2.4	18.4	43	31	....	+	++	0	0	++	+	0	0	....	....	....	?	....		NGC7026
21052+4202	21 05 09.4	42 02 03	*300*	*1500*	*600*	*240*	....	+	++	+	....	....	....	0	0	0	+	+	+	....	+	*NGC7027*
21282+5050	21 28 15.0	50 50 43	51.0	74.4	33	15	0	0	0	0	0	0	0	0	0	0	+	+	+	+	+	
21306+4422*	21 30 37.2	44 22 31	11.3	47.1	24	9	0	+	+	0	....	....	....	0	0	0	+	+	+	+	+	IC5117
22219+5042*	22 21 55.9	50 42 44	0.4	3.2	5	2 L	....	0	+	0	....	....	....	....	....	....	....	....	....	....		IC5217
22384+6101	22 38 28.1	61 01 26	3.6	35.2	49	29	0	0	++	0	0	++	+	....	....	0	0	0	0	....		NGC7354
23234+4215	23 23 29.8	42 15 37	3.8	35.0	37	17	....	0	++	0	0	++	0	....	....	0	....	....	....	....		NGC7662
23239+5754	23 23 57.6	57 54 24	20.9	71.2	36	13	....	0	0	+	0	0	0	+	+	0	0	0	0	....	?	HB12

TABLE III. *Miscellaneous.*

IRAS NAME	POSITION (1950.0)		Point Source Catalog Fluxes (Jy)				IONIC LINES							SIL.		SIC	PAHs					ASSOCIATION
	α (h m s)	δ (° ' ")	12 µm	25 µm	60 µm	100	NeVI (7.6µm)	ArIII (9.0µm)	SIV (10.5µm)	NeII (12.8µm)	NeV (14.3µm)	NeIII (15.5µm)	SIII (18.7µm)	10 µm	18 µm	11.5 µm	7.7µm	8.6µm	11.3µm	Plateau (12 µm)	3.3µm	
01556+4511	01 55 37.9	45 11 34	499.1	291.5	42	16	0	0	0	?	0	0	0	+	+	0	0	0	0	0		HD11979
02427-5430	02 42 42.0	- 54 30 44	181.0	99.8	11	4	0	0	0	?	0	0	0	+	+	0	0	0	0	0		W Hor
07034-3551	07 03 28.5	- 35 51 50	252.6	136.3	17	8	0	0	0	+	0	0	0	+	+	0	0	0	0	0		HD53917
09088-5050	09 08 50.5	- 50 50 15	14.4	5.4	3 L	29 L	0	0	0	+	....	....	....	0	0	0	+	?	?	0		
09394-4909	09 39 24.8	- 49 09 03	11.8	7.8	1	9 L	0	0	0	0	0	0	0	0	0	0	0	0	0	0		He2-34
17150-3224	17 15 04.6	- 32 24 15	57.9	322.3	268	82	0	0	0	0	0	0	0	-	-	0	0	0	0	0		AFGL6815S
18184-1302	18 18 26.7	- 13 02 54	336.0	597.5	253 :	436 L	0	0	0	0	0	0	0	0	0	0	+	+	+	+	+	AFGL2132
20310+4029	20 31 01.5	40 29 37	179.0	112.4	75 L	85 :	0	0	0	+	0	0	0	-	-	0	0	0	0	0		MCW349
23541+7031	23 54 06.7	70 31 35	91.4	92.3	56	27	0	0	0	0	0	0	0	-	-	0	0	0	0	0		M2-56

REFERENCES ON PLANETARY AND PROTO PLANETARY NEBULAE

M4-18: Aitken and Roche (1982) ; Cohen et al. (1986) for the 7.7 µm feature
CRL618: 3.3 µm from Russell et al. (1978)
IC418: SIV from Beck et al. (1981); 7.7, 11.3 and NeII from Willner et al. (1979); 3.3 µm from Russell et al. (1977b)
IC2149: 3.3 µm from Martin (1983, 1987)
HD44179: 7.7 µm in Cohen et al. (1986) and 3.3, 8.6 and 11.3 µm in Russell et al. (1977b)
IC2165: ArIII from Beck et al. (1981); SIV, NeII, 8.6 and 11.3 from Roche and Aitken (1983)
J900: ArIII, SIV, NeII, 8.6 and 11.3 µm from Aitken and Roche (1982); 3.3 µm from Martin (1987)
M1-6: Roche and Aitken (1986)
M1-11: NeII, 8.6, 11.3 µm from Aitken and Roche (1982); 7.7 µm from Cohen et al. (1986); 3.3 µm from Martin (1987)
M1-12: Roche and Aitken (1986)
NGC2392: SIV from Roche et al. (1983)
NGC2392: SIV from Roche et al. (1983)
NGC2440: 3.3 µm from Martin (1987)
NGC2792: Beck et al. (1981)
NGC2867: Beck et al. (1981)
IC2501: ArIII, SIV and NeII from Beck et al. (1981); 11.3 µm from Aitken and Roche (1982); 3.3 µm from Allen et al. (1982)
He2-47: NeII , silicate at 10 µm and 8.6 and 11.3 µm in Aitken and Roche (1982)
NGC3242: NeII in Beck et al. (1981); 8.6 and 11.3 µm in Roche et al. (1983); 3.3 µm from Martin (1987)
NGC2621: ArIII and SIV in Beck et al. (1981) and Aitken and Roche (1982)
NGC3918: ArIII and SIV in Beck et al. (1981)
He2-90: NeII and Silicate at 10 µm in Aitken and Roche (1982)
MyCn18: ArII, SIV and NeII in Beck et al. (1981)
NGC5315: NeII, 8.6 and 11.3 µm in Aitken and Roche (1982)
He2-113: NeII, Silicate at 10 µm, 8.6 and 11.3 µm in Aitken et al. (1980); 3.3 µm from Allen et al. (1980)
NGC5822: ArIII, SIV and NeII in Beck et al. (1981)
He2-131: NeII, 8.6 and 11.3 µm in Aitken and Roche (1982)
Mz3: NeII, 8.6 and 11.3 µm in Aitken and Roche (1982)
NGC6210: ArIII, SIV and NeII in Beck et al. (1981)
IC4634: ArII, SIV and NeII in Beck et al. (1981)
M2-9: 11.3 µm and silicates at 10 µm in Aitken and Roche (1982)
CP-56°8032: NeII, 7.7, 8.6 and 11.3 µm in Aitken et al. (1980); 3.3 µm from Allen et al. (1982)
NGC6302: NeVI, NeII and 11.3 µm in Roche and Aitken (1986)
NGC6309: ArIII, SIV and NeII in Beck et al. (1981)
NGC6369: ArIII, SIV, NeII, 8.6 and 11.3 µm in Roche et al. (1983
HB4: ArIII, SIV, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
M1-26: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken et al. (1979)
HB5: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken and Roche (1982)
HB6: ArIII, SIV, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
NGC6543: ArIII andSIV from Roche et al. (1983); 3.3 µm from Martin (1987)
NGC6537: ArIII, SIV and NeII in Beck et al. (1981)
NGC6572: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken and Roche (1982) and Willner et al. (1979)
SwSt1: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken and Roche (1982)
Cn3-1: ArIII, SIV, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
Hu2-1: ArIII, SIV, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
NGC6741: ArIII, SIV, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
NGC6790: ArIII, SIV and NeII in Beck et al. (1981); 7.7 µm in Cohen et al. (1976); 8.6, 11.3 µm in Aitken et al. (1979)
Vy2-2: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken and Roche (1982)
NGC6803: ArIII, SIV and NeII in Beck et al. (1981) and Grasdalen (1979)
BD+30°3639: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken and Roche (1982); SIII in Shure et al. (1983); 3.3 µm from Russell et al. (1977b)
NGC6884: ArIII, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986); SIV in Beck et al. (1981)
NGC6881: ArIII, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
NGC6886: ArIII, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
He2-459: ArIII, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
IC4997: NeII and silicate at 10 µm in Aitken and Roche (1982); ArIII in Beck et al. (1981)
NGC7009: ArIII, SIV and NeII in Beck et al. (1981)
NGC7026: ArIII, SIV and NeII in Beck et al. (1981); Grasdalen (1979)
NGC7027: ArIII, SIV and NeII from Beck et al. (1981); NeV from Forrest et al. (1980) 3.3 to 11.3 µm features from Russell et al. (1977a)
21282+5050: 3.3 µm in Muizon et al. (1986)
IC5117: ArIII, SIV, NeII, 8.6 and 11.3 µm in Aitken and Roche (1982); 7.7 in Cohen et al. (1986)
IC5217: ArIII, NeII, 8.6 and 11.3 µm in Roche and Aitken (1986)
NGC7662: SIV in Beck et al. (1981)
HB12: NeII, 8.6 and 11.3 µm in Aitken and Roche (1982); 3.3 µm, Martin (1987)

TABLE IV. *Planetary nebulæ and proto-planetary nebulæ – Other information.*

Iras Name	Association	Nature	θ_{opt} (")	Distance (kpc)	Atomic Lines	CO	H_2	HI	C/O	* exc	opt exc	References	Notes
00102+7214	NGC 40	PN	50		0	0	...	...	1.25	WC8	Low	(22) (21) (12) (50), (4)	
01539+6304	IC1447	PN	13	2.5	...	...	...	...	1.9	WC4	High	(19) (50) (3)	PK
04215+6000	M4-18	PN	small		...	...	...	...	...	WC11	Very Low	(50) (41)	PK
04395+3601	CRL618	PN	7		0	+	+	...	≥1	...	...	(8) (51) (50)	
05251-1244	IC418	PN	10		0	0	0	HI	1.3	...	Low	(21) (54) (48) (46) (50), (4)	PK
05526+4605	IC2149	PN	15x5		...	0	...	...	...	...	Low	(9) (21) (10)	Bipolar
06175-1036	HD44179	PPN	40x25		0	+	...	...	...	B9	Very Low ?	(13) (8)	Bipolar
06196-1257	IC2165	PN	6		[Cl IV]	0	...	...	3.2	...	High	(38) (21) (50) (4)	PK
06230+1749	J 900	PN	10		...	0	+	...	4	...	High	(8a) (21) (51) (50) (4)	PK
06332-0003	M1-6	PN	<5		...	0	...	...	...	...	Very Low	(8a) (21) (31)	PK
07027-7934		PPN?			...	+	...	...	...	...	...	(31b)	
07091-1946	M1-11	PN	small		0	0	...	...	...	...	Very Low	(8a) (25)	PK
07172-2138	M1-12	PN	small		...	0	...	...	...	...	Very Low	(8a) (30)	PK
07262+2100	NGC2392	PN	40		[O IV]	0	...	...	0.58	...	High	(9) (42) (21) (50) (3)	
07396-1805	NGC2440	PNI	15	2.19	...	+	+	...	0.6	...	High	(19) (21) (51) (50), (2)	PK
09105-4213	NGC2792	PN	13	1.91	...	...	...	...	...	...	High	(19) (23)	PK
09200-5805	NGC2867	PN	12		...	0	...	...	1.5	WC3	High	(8a) (50) (28) (20)	PK
09373-5951	IC2501	PN	<2		...	0	...	...	1.2	...	Medium	(8a) (50) (28)	
10162-6225	NGC3211	PN	14	1.91	...	...	...	...	2.5	WC6	High	(19) (50) (28)	PK
10214-6017	He2-47	PN	<5		0	...	...	...	...	...	Very Low	(1)	PK
10223-1823	NGC3242	PN	40	0.5	0	0	0	...	0.59	...	High	(9) (19) (21) (48) (50) (4)	
10583-6458	IC2621	PN	5		0	0	...	...	1.2	...	Medium	(54) (50) (28)	PK
11478-5659	NGC3918	PN	13	2.24	0	...	...	...	1.8	...	High	(19) (50) (28)	
12276-6435	He2-86	PN	<5		0	...	...	...	...	...	Medium	(23)	PK
13064-6103	He2-90	PN	<10		0	...	...	...	...	...	Low	(45)	PK
13359-6707	MyCn18	PN	<25		0	...	...	...	...	...	Low	(23)	PK
13501-6616	NGC5315	PNI	5	2.62	0	0	...	...	2.5	WC6	High	(19) (54) (50) (28)	PK
14562-5406	He2-113	PN	?		0	0	...	...	...	WC10	Very Low	(50) (31c) (54)	
15022-5547	He2-117	PN	<5		0	...	...	...	...	...	Medium	(23)	PK
15134-4527	NGC5822	PN	7		0	...	...	...	...	...	Medium	(28)	PK
15198-5658	Pe2-8	PN	<10		0	...	...	...	...	...	Medium	(43)	PK
15318-7144	He2-131	PN	6	0.60	0	...	...	...	0.3	...	Very Low	(19) (50) (43)	PK
15476-4836	Cn1-1	PN	small		0	...	...	...	...	...	Medium	(34)	PK
16133-5151	Mz3	PNI	12		0	...	+	...	...	...	Very Low	(48) (43)	PK
16268-4556	Pe1-7	PN	<5		0	...	...	...	...	WC9	Very Low	(32) (43)	PK
16280-4008	NGC6153	PN	25		0	0	0	...	...	...	High	(54) (d) (48) (36)	PK
16423+2353	NGC6210	PN	25		0	0	+	...	...	...	Medium	(11) (21)(44) (4)	
16585-2145	IC4634	PN	10		0	...	...	...	0.33	...	Medium	(50) (4)	PK
17027-1004	M2-9	PNI	26		[OI]	+	+	...	...	...	Low?	(22) (17) (8) (44) (43)	Bipolar
17047-5650	CPD-56°8032	PN	small		0	+	...	...	>1	WC10	Very Low	(37) (54) (31b) (50) (15)	
17069-4149	H1-7	PN?	8		0	...	...	...	...	...	...		PK
17103-3702	NGC6302	PNI	80x30		[NeVI]	+	+	HI, OH	0.2	...	High	(21) (44) (40) (35) (50) (54)	PK, Bipolar
17112-1251	NGC6309	PN	32		0	0	...	...	...	...	High	(22) (4) (35a) (47)	
17180-2708	M3-39	PN	16		0	...	...	...	...	...	Medium?	(23)	PK
17262-2343	NGC6369	PN	30	2.0	0	0	...	...	2	...	Medium	(19) (21) (50) (6)	PK
17388-2440	HB4	PN	6		0	0	...	...	...	...	High	(21) (6)	PK
17427-3010	M1-26	PN	<5	0.5	0	0	...	...	0.5	...	Very Low	(8a) (21) (50) (49)	PK
17447-2958	HB5	PNI	20x10		0	...	+	...	...	...	High	(48) (6)	PK, Bipolar
17521-2144	HB6	PN	6	2.24	0	...	...	...	...	...	High	(6)	PK
17534-1628	M1-32	PN	8		0	...	...	...	...	...	Low	(23)	PK
17584+6638A	NGC6543	PN	12		0	0	...	...	2.2	...	Medium	(22) (21) (50) (4)	
18021-1950	NGC6537	PNI	10		0	0	...	...	...	...	High	(19) (54) (34)	PK, Bipolar?

TABLE IV. *(continued)*

Iras Name	Association	Nature	θ_{opt} (")	Distance (kpc)	Atomic Lines	CO	H_2	HI	C/O	* exc	opt exc	References	Notes
18096+0650	NGC6572	PN	14	0.41	[OI]	0	0	...	i.1	...	Medium	(22) (19) (21) (17) (50) (3) (47)	
18129-3053	SwSt1	PN	<0.5		0	0	...	...	0.72	...	Very Low	(50) (b) (3)	PK
18132-2028	NGC6578	PN	8.5	2.0	0	...	...	...	...	...	Medium	(19) (6)	PK
18152+1007	Cn3-1	PN	5		...	0	...	...	...	...	Low	(21) (6) (54)	PK
18226-2313	NGC6629	PNI	15		...	...	...	...	...	...	Low	(6)	PK
18476+2047	Hu2-1	PN	3		...	0	...	...	>1 ?	...	Low	(21) (33) (3)	PK
18517+3257	NGC6720	PN	78	0.65	...	+	+	...	?	...	High	(22) (19) (21) (11) (42) (10)	
19000-0031	NGC6741	PNI	6		...	0	...	...	1.6	...	High	(21) (50) (5)	PK
19032-0604	NGC6751	PNI	20		...	0	...	...	...	WC6	Medium?	(35a) (50) (3)	PK
19204+0124	NGC6790	PN	8		0	0	0	HI?	1.7	...	Medium	(21) (48) (18) (50) (4)	PK
19219+0947	Vy2-2	PN	small		0	0	...	OH	<1	...	Low?	(27) (21) (16) (50) (24)	PK
19289+0956	NGC6803	PN	5.5	3.0	...	...	...	...	...	...	Medium	(19) (4)	PK
19327+3024	BD+30°3639	PN	7		...	0	+	...	>2.8	WC9	Very Low	(9) (b) (21) (42) (50) (41)	
19342+1935	M1-71	PN	5		...	...	...	...	...	...	Medium	(29)	PK
19434+5024	NGC6826	PN	≤26	2.19	...	0	...	...	7	...	Medium?	(4) (21) (50)	
20088+4618	NGC6884	PN	6	1.8	...	0	...	...	1.9	...	High	(19) (21) (50) (4)	PK
20090+3715	NGC6881	PN	4		...	0	...	...	...	...	High	(19) (21) (6) (26)	PK
20104+1950	NGC6886	PN	5	1.7	...	0	...	...	1.4 (or 2.3)	...	High	(19) (21) (50) (3)	PK
20119+2924	He2-459	PN?	<10		0	...	...	...	...	...	...		PK
20179-1634	IC4997	PN	<2		...	0	...	HI	0.4	WC10	Medium	(21) (48) (7) (50) (2)	PK
20590+5420	NGC7008	PNI	80		...	?	...	...	...	...	High	(22) (b) (21) (25)	
21014-1103	NGC7009	PN	25	0.58	0	0	...	...	?	...	High	(9) (19) (21) (48) (11) (47) (3)	
21046+4739	NGC7026	PN	25x15	2.18	0	0	...	...	1.7	WC3	Medium	(22) (19) (b) (21) (50) (4)	Bipolar
21052+4202	NGC7027	PN	10	1.1	[NeV] [OIV] etc....	+	+	HI, HCN C_3H_2	3.5		High	(19) (42) (34a) (17) (50) (3) (53)	PK
21282+5050		PPN?	<1.2		...	+	...	...	...	WC11	Low	(21) (31a) (14) (52)	
21306+4422	IC5117	PN	small		...	+	+	...	2	WC	Medium	(21) (42) (50) (4)	PK
22219+5042	IC5217	PN	10x5		...	0	...	...	...	...	Medium	(9) (21) (10)	
22384+6101	NGC7354	PN	20	1.5	[NeV] [OIV]	0	...	...	...	...	High	(22) (48) (42) (21) (6)	
23234+4215	NGC7662	PN	14	0.98	[NeV] [OIV]	0	+	...	1.7	...	High	(22) (19)(42) (b) (21)(50)(4)	
23239+5754	HB12	PN	<10		0	...	+	...	0.3	...	Low	(51) (50) (4)	PK

References

(1) Aitken and Roche, 1982; (2)Aller and Walker, 1970; (3) Aller and Czyzak, 1979; (4) Aller and Czyzak, 1983; (5) Aller and Keyes, 1985; (6) Aller and Keyes, 1987; (7) Altschuler et al., 1986; (8) Bachiller et al., 1988;(8a) Bachiller, private communication; (9) Balick, 1987; (10) Barker, 1978; (11) Bogdanovitchet al., 1986; (12) Clegg et al., 1983; (13) Cohen et al., 1975; (14) Cohen and Jones, 1987; (15) Cowley and Hiltner, 1969; (16) Davis et al., 1979; (17) Dinerstein et al., 1985; (18) Gathier, 1984; (19) Gathier, 1987; (20) Gutteriez-Morens et al., 1985; (21) Huggins and Healy, 1989; (22) Jewitt et al., 1986; (23) Keler, 1976; (24) Kaler, 1980; (25) Kaler, 1983; (26) Kaler, 1985; (27) Kaler et al., 1987; (27) Knapp, 1985; (28) Kohoutek and Martin, 1981; (29) Kondrat'eva, 1978; (30) Kondrat'eva, 1979; (31) Kwok and Purton, 1983;(31a) Likkel et al., 1988; (31b) Loup et al., 1989; (31c) Loup, private communication; (32) Lundstrom and Stenholm, 1984; (33) Lutz, 1981; (34) Lutz, 1984; (35)Payne et al., 1988; (35a) Phillips et al., (1989); (35a) Masson et al., 1985; (36) Pottasch et al., 1986; (37) Rao, 1987; (38) Roche and Aitken, 1983; (39) Roche and Aitken, 1986; (40) Rodriguez and Moran, 1982; (41) Sabbadin and Bianchini, 1979; (42) Shure et al., (1983); (43) Stenholm and Acker, 1987; (44) Storey et al., 1987; (45) Swings, 1973; (46) Taylor and Pottasch, 1987; (47) Webster, 1983; (48) Webster et al., 1988; (49) Webster, 1988; (50) Zuckerman and Aller, 1986; (51) Zuckerman and Gatley, 1986; (52) Shibata et al., (1989); (53) Wilner et al., 1989; (54) Sahai et al., 1989;

TABLE V. *Statistics for H II regions, reflection nebulæ and embedded young stellar objects.*

Certain PAH emission	
3 bands certain, plateau certain	56
3 bands certain, possible plateau	55
Sub-Total	111
Possible PAH emission	
3 bands uncertain	32
7.7 μm certain, possible 11.3 μm	21
11.3 μm certain, possible 7.7 μm	7
Sub-Total	60
No PAH emission	
Without PAH, but with strong silicate absorption	15
Without PAH, without silicate absorption	6
Sub-Total	21
Total	192

Notes to Table 5:

1. "3 bands" means the 3 PAH emission bands in the LRS spectral range i.e. 7.7, 8.6 and 11.3 μm
2. "Plateau" means emission plateau at 11.5–13 μm

TABLE VI. *Statistics for planetary nebulæ and proto-planetary nebulæ.*

		C/O ≥ 1 or WC star	C/O ≤ 1	C/O unknown	Total
Certain PAH emission	3 bands certain, plateau certain	5	0	1	6
	3 bands certain, no plateau	2	0	3	5
Possible PAH emission	11.3 μm band certain, others uncertain	6	0	3	9
	3 bands uncertain	11	3	3	17
No PAH emission	certainly no PAHs	1	6	20	27
	PAHs undetected	7	2	10	19
Total		32	11	40	83

Notes to Table 6:

1. "3 bands" means the 3 PAH emission bands in the LRS spectral range i.e. 7.7, 8.6 and 11.3 μm
2. "Plateau" means emission plateau at 11.5–13 μm
3. The C/O data are taken from Table 4

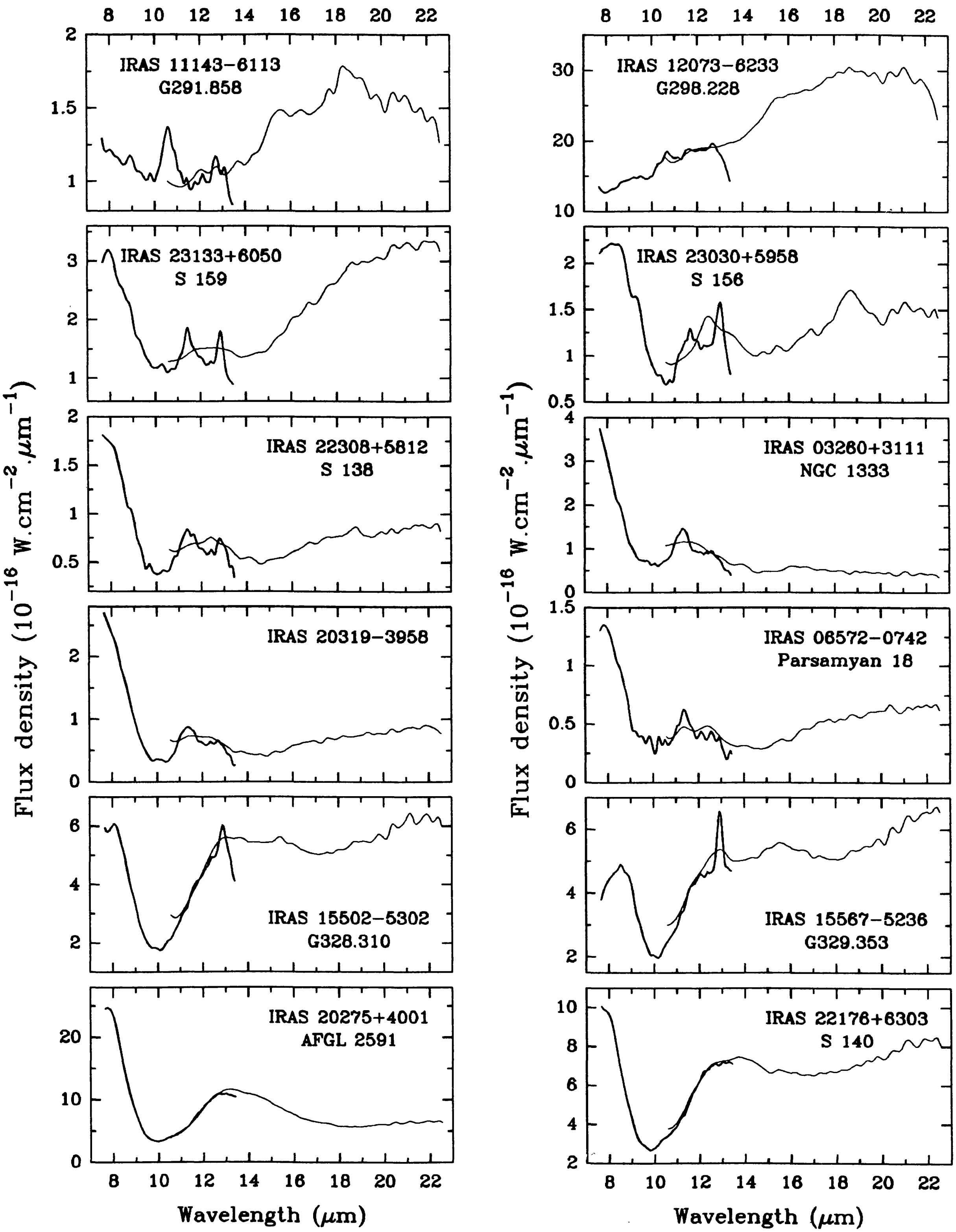

FIGURE 1. – LRS spectra of selected H II regions, reflection nebulæ and embedded young (proto-) stellar objects. In each spectrum, the thick line is band 1 of the LRS and the thin line is band 2. In the overlapping range of the two bands (10.5 – 13.5 μm) the data do not superpose precisely due to the resolution being higher in band 1 ($\approx$ 50 – 60) than in band 2 ($\approx$ 15 – 20) at these wavelengths. From top to bottom, sources are displayed in order of increasing optical thickness of the dust shell or cocoon. Comments on individual sources are given in the text

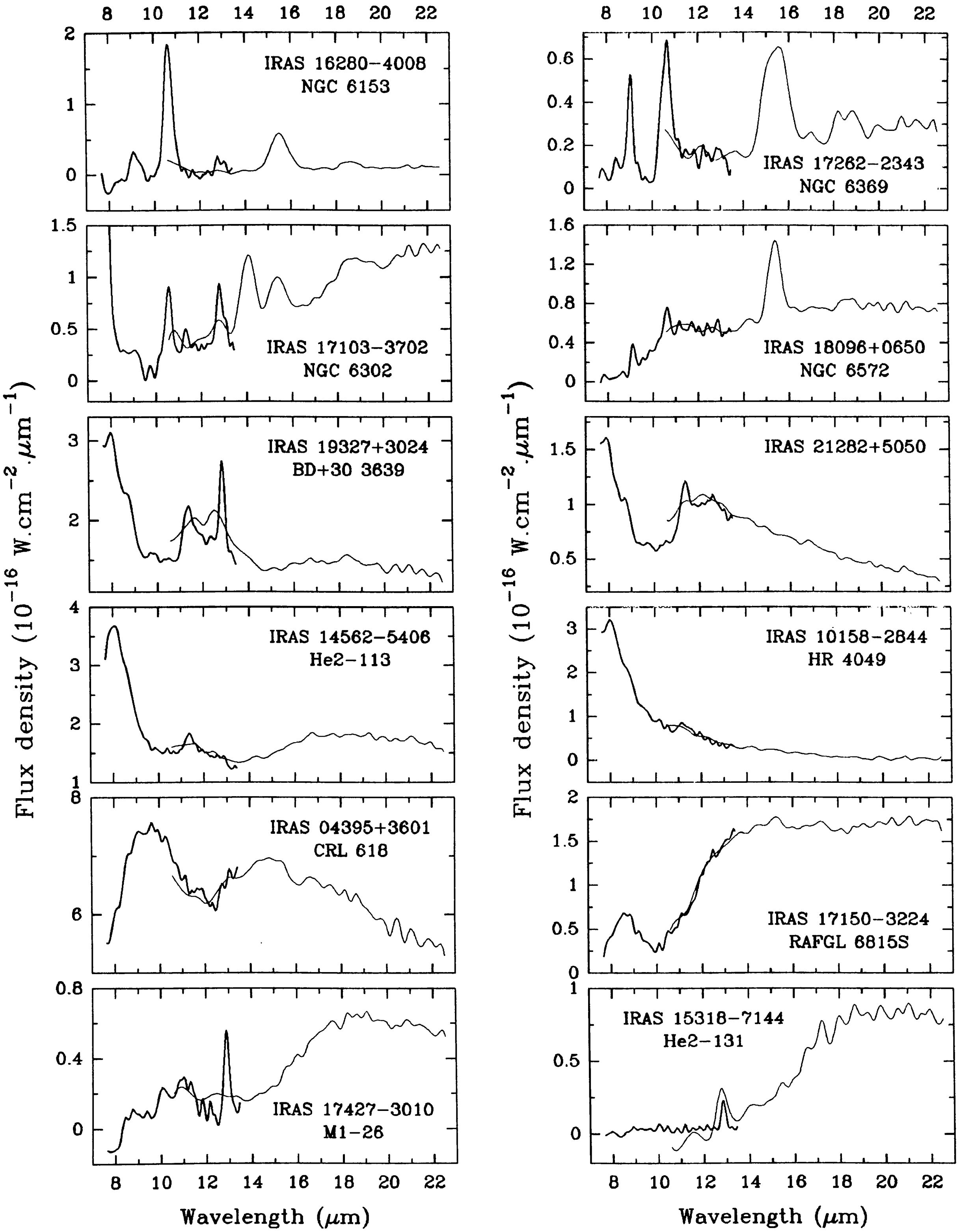

FIGURE 2. – LRS spectra of selected planetary and proto-planetary nebulæ. In each spectrum, the thick line is band 1 of the LRS and the thin line is band 2. In the overlapping range of the two bands (10.5 – 13.5 μm) the data do not superpose precisely due to the resolution being higher in band 1 ($\approx$ 50 – 60) than in band 2 ($\approx$ 15 – 20) at these wavelengths. Individual sources are described in the text

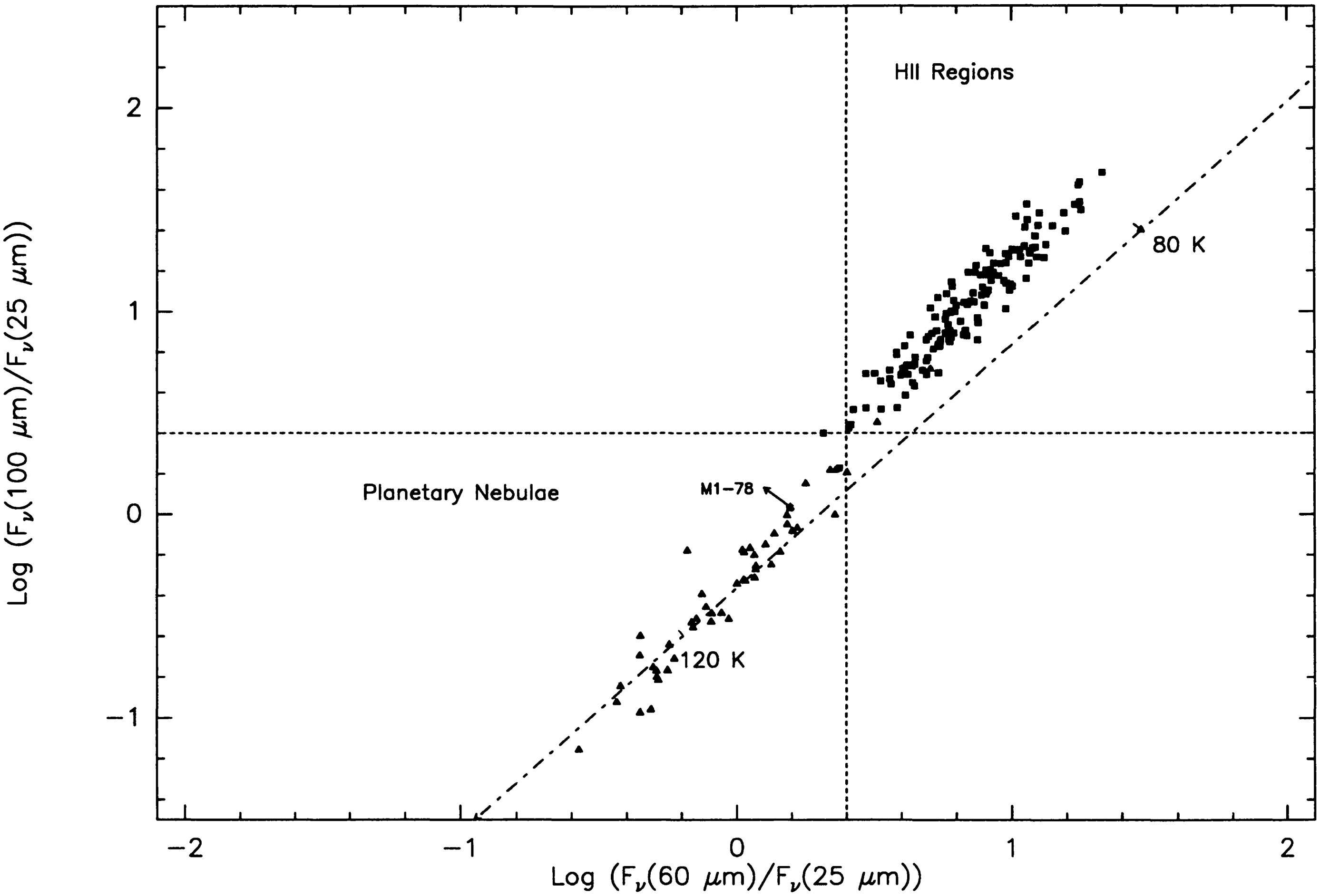

FIGURE 3. – Plot of log($F_\nu(100\ \mu m)/F_\nu(25\ \mu m)$) against log($F_\nu(60\ \mu m)/F_\nu(25\ \mu m)$) for H II regions and reflection nebulæ (squares) and planetary nebulæ (triangles). The dashed lines indicate the division between the two groups. The black body curve is shown by the dot-dashed line