INFRARED EMISSION FROM SPIRAL GALAXY NUCLEI

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At the present time we do not know with any certainty what the infrared properties of "normal" galaxies are, although we do know that substantial broad-band emission at 10μm is fairly common in spiral galaxies; Rieke and Lebofsky (1978), for example, were able to detect the nuclei of 16 out of 39 bright spiral galaxies above a level of about 50 mJy. Only one of these, NGC 1068, is a Seyfert Galaxy.

With the exception of M31, whose 10μm emission can be accounted for entirely by stellar photospheric emission, all the spiral galaxies detected in Rieke and Lebofsky's survey show strong emission from heated dust grains. Airborne observations at longer wavelengths (e.g., Telesco and Harper 1980) of a few of these galaxies show a peak in the energy distribution at around 80μm, corresponding to dust temperatures of order 30-60K, while spatial scans, and multi-aperture photometry at 10μm (Rieke 1976; Becklin, Fomalont, and Neugebauer 1973; Becklin et al. 1980) indicate a physical size for the emitting region of a few hundred parsecs diameter.

In Table 1 are listed most of the spiral galaxies for which measurements have been reported at wavelengths longer than 20μm. It may be seen that there is a very wide range of luminosity even if the Seyfert Galaxy NGC 1068 is excluded as a special case. The luminosity distribution is very poorly determined mainly because of the difficulty of detecting the fainter galaxies; it is quite possible, for example, that there are many galaxies fainter than our own.

Since the 2.2μm radiation from almost all galaxy nuclei is dominated by photospheric emission from late-type stars (Aaronson 1977) the ratio of flux density at 80μm to that at 2.2μm, through the same sized diaphragm, is a crude but useful indication of the ratio of infrared luminosity to luminosity in the form of starlight; a ratio of about 40 corresponds to equal luminosities in the two wavelength ranges. The ratios given in the table are uncertain by a value of about two because of uncertainties in 2μm extinction and in beam size corrections, but they show clearly that the more powerful galaxies require an

Patrick A. Wayman (ed.), Highlights of Astronomy, Vol. 5, 173–175.

Table 1

	Infrared Luminosity (10^9 $L_\odot$)	$S_{80}/S_{2.2}$	References
M31	< 0.4	< 10	1,2
The Galaxy	1	50	3,4,5
M51	5	50	1,2
IC 342	5	400	6
NGC 2903	7	130	1,2
NGC 5236	20	200	1,2
NGC 6946	20	350	1,2
NGC 253	30	400	1,7
NGC 1068	300	400	1,2

1) Telesco and Harper 1980
2) Aaronson 1977
3) Low _et al_. 1977
4) Maihara, Oda, and Okuda 1979
5) Oda _et al_. 1979
6) Becklin _et al_. 1980
7) Wynn-Williams _et al_. 1979

additional source of luminosity than just their normal population of stars. What this source of luminosity is must be determined by detailed studies of individual objects. The three best studied galaxies are M82 (e.g., Rieke _et al_. 1980), NGC 253 (e.g., Wynn-Williams _et al_. 1979) and IC 342 (Becklin _et al_. 1980). In these galaxies there is strong evidence, based partly on the presence of large amounts of both molecular and ionized gas and non-thermal radio radiation as well as the infrared emission that substantial star formation is taking place in their central regions under conditions which may not differ greatly from those in our Galaxy. The infrared emission presumably originates in dust heated by the newly formed stars and protostars. Why some galaxies show this activity and others do not is at present quite unknown.

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