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FAR-INFRARED EMISSION FROM DUSTY ELLIPTICALS

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The incidence of dust lanes in elliptical galaxies has been estimated at $\sim 40\%$ by Sadler and Gerhard (1985), although the observed fraction is lower because of inclination effects. A similar percentage of ellipticals has been detected by *IRAS* at 100 μm (Knapp *et al.* 1989); these have far-infrared colors expected for emission from cool dust ($S_{60\,\mu m}/S_{100\,\mu m} \sim 1/3$).

Table 1 shows the fractions of ellipticals detected at 100 μm as a function of reported dust. The references are: EDD = Ebneter, Djorgovski and Davis (1987); SG = Sadler and Gerhard (1985); Sp = Sparks *et al.* (1985); VC = Veron Cetty and Veron (1987); L = Lauer (1985); and EB = Ebneter and Balick (1985). The classifications as ellipticals are taken from Knapp *et al.* (1989). In each case, the dusty galaxies are more often detected by *IRAS* than those with no optical evidence for dust. Part of the reason for this difference may be attributed to the fact that distant galaxies are not likely to be detected at 100 μm or to show the presence of dust. However, it can be shown - by weighting galaxies according to distance - that this is not sufficient to account for the large differences. Hence, not surprisingly, DUST $\Rightarrow$ Far-IR Emission.

For the far-infrared detected galaxies, neither $L_{100\,\mu m}/L_B$ nor $L_{60\,\mu m}/L_{100\,\mu m}$ is very dependent on dust content, suggesting that the source of the infrared luminosity is the same in both cases; and hence that dust is responsible even when not detected optically.

Despite this indication, $L_{100\,\mu m}$ does not prove to be a good indicator of the quantity of cool interstellar matter in elliptical galaxies, as measured by the mass of neutral hydrogen. (There even exist several examples of ellipticals with dust, strong 100 μm flux density and sensitive limits on H I mass [Walsh *et al.* in preparation].) Chief reasons for the lack of correlation include (1) The existence of other important sources of far-IR power in ellipticals, such as nonthermal continuum emission extending from longer wavelengths in flat spectrum radio sources (Golombek, Miley and Neugebauer 1988), (2) Far-infrared luminosity per unit dust mass is extremely sensitive to the temperature of the ambient radiation field, which is not accurately known.

In addition to having their appearance distorted by dust, several ellipticals also show such features as shells, box-shaped isophotes or inner disks. These may be signatures of past mergers, which could also add to the ISM content of the system. Table 2 shows detection rates for samples of ellipticals belonging to each class. The shell galaxies are from the lists of Thronson, Bally and Hacking (1989); the others are from Nieto (1988). Both the shell galaxies and those with boxy isophotes show enhanced detections relative to the "expected" number (taken to mean the fraction from the comparison sample of Knapp *et al.* [1989] which would be detected if they had the same distance distribution as the small samples in question). However, since (at least for the boxy isophote galaxies) there is a correlation between presence of a "feature" and the blue luminosity, a larger number of ellipticals in each class is needed before the numbers are to be trusted.

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TABLE 1

INFRARED DETECTION RATES FOR DUSTY ELLIPTICALS

Reference		Detected at 100 μm	
EDD	Dust	7/12	(58%)
	Possible Dust	9/28	(32%)
	No Dust	27/78	(35%)
SG	Dust	4/4	(100%)
	No Dust	14/27	(52%)
Sp	Dust	6/7	(86%)
	Possible Dust	1/3	(33%)
	No Dust	8/21	(26%)
VC	Dust	9/10	(90%)
	Possible Dust	2/7	(29%)
	No Dust	24/38	(63%)
L	Dust	3/4	(75%)
	No Dust	18/36	(50%)
EB	Dust	18/23	(78%)

TABLE 2

ELLIPTICALS WITH "FEATURES"

	Detected at 100 μm		"Expected"
Shells	14/23	(61%)	47%
Boxy Isophotes	13/21	(62%)	47%
Inner Disks	12/28	(43%)	43%
Comparison Sample	202/478	(42%)	—