INFRARED LUMINOSITIES OF MARKARIAN STARBURST GALAXIES

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Optical observations (Balzano 1983) have found many galaxies with unusually blue colors, stellar or semi-stellar nuclei, and emission line spectra with narrow line widths and line ratios implying stellar ionization. Balzano concluded that these properties could be explained by a recent burst of star formation; since almost all of the galaxies were selected from the Markarian lists, they are referred to as "Markarian starburst galaxies." We have compared the far infrared luminosities of these galaxies with a sample of normal spiral galaxies (Scoville et al. 1983). We have also compared the far infrared luminosities of the Markarian starburst galaxies to their blue light and Hα luminosities.

The far infrared data consist of measurements from the IRAS Point Source Catalog. For the starburst sample, 81 galaxies were detected, 18 were observed but not detected, and 3 were not observed. For the comparison sample, 54 galaxies were detected, and 6 were observed but not detected. Luminosity functions were calculated taking into account both detections and upper limits (Avni et al. 1980). The starburst galaxies have a median luminosity of $1.4\times10^{10}L_{\odot}$, compared to $3\times10^{9}L_{\odot}$ for the normal spirals. Both samples show a range of luminosity of about an order of magnitude. Another difference between the samples is that the 60 to 100μm color temperature is higher for the starburst than for the normal galaxies. These properties indicate that the starburst galaxies indeed contain many more hot, young stars than the normal galaxies.

The far infrared luminosities of the starburst galaxies are almost always greater than the blue luminosities derived from the total photographic magnitudes (Zwicky et al. 1961-1968). This implies that dust absorbs and re-emits most of the radiation from the young stars. The blue optical appearance of these galaxies must be a fortuitous result of our line of sight, and there should be many similar galaxies that have not been identified because they are heavily reddened in our direction. The nearby galaxies M 82 and NGC 253 may be examples of reddened starburst galaxies (Rieke et al. 1980).

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The four quantities observed for each starburst galaxy - far infrared luminosity, total blue luminosity (Zwicky et al. 1961-1968), nuclear blue luminosity (Balzano 1983), and nuclear Hα luminosity (Balzano 1983) - are all correlated. Table 1 gives the 6 correlation coefficients. The quantities in Table 1 were calculated non-parametrically and take into account both detections and upper limits.

TABLE 1

STARBURST LUMINOSITY CORRELATION COEFFICIENTS

	FIR	Hα(nuc)	M_p(total)
Hα(nuc)	0.77		
M_p(total)	0.84	0.68	
M_B(nuc)	0.83	0.82	0.85

The far infrared luminosity is better correlated with blue light (both nuclear and total) than with Hα emission. Since the blue light is emitted mostly by B and A stars, while the Hα production is dominated by O stars, we conclude that the B and A stars are mainly responsible for heating the dust. This implies either that O stars were never formed in large numbers or, more likely, that the age of a typical burst being observed now is greater than the main sequence lifetime of an O star (about 10^7 years).

REFERENCES

Avni, Y., Soltan, A., Tananbaum, H., and Zamorani, G. 1980, Astrophys. J. **238**, 800.

Balzano, V. 1983, Astrophys. J. **268**, 602.

Rieke, G. H., Lebofsky, M. J., Thompson, R. I., Low, F. J., and Tokunaga, A. T. 1980, Astrophys. J. **238**, 24.

Scoville, N. Z., Becklin, E. E., Young, J. S, and Capps, R. W. 1983, Astrophys. J. **271**, 512.

Zwicky, F., Herzog, E., Wild, P., Karpowicz, M., and Kowal, C. 1961-1968, Catalog of Galaxies and of Clusters of Galaxies (Pasadena:California Institute of Technology).

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