CONTINUUM WAVELENGTH EMISSION FROM EMBEDDED, YOUNG, AND MASSIVE STELLAR OBJECTS BEYOND 1 μm

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ABSTRACT. One of the components of the galactic infrared background (GIRB) radiation is emission by warm dust grains heated by OB stars embedded in molecular clouds. The main contributors are compact HII regions and comparatively radioquiet infrared (IR) point sources such as the Becklin-Neugebauer object. We present the average energy distribution between 1 and 1300 μm for a sample of BN-type objects. The average color temperature between 60 and 100 μm is ~40 K, which is very similar to the color temperature of the observed warm galactic dust emission (WGDE).

1. INTRODUCTION

The WGDE contributes about 20% to the total galactic IR luminosity (see Cox and Mezger 1989; CM). This emission component is mainly connected with discrete sources. OB stars remain for about 10–20% of their lifetimes embedded in molecular clouds (Cox, Krügel, and Mezger 1986) and heat the surrounding dust. The blister phase that follows is probably of less importance for the production of WGDE (Leisawitz and Hauser 1988). CM estimated that only one third of WGDE comes from extended blister HII regions.

Because the total emission rises with T_d^6, the amount of warm dust is very small. However, the investigation of this component is of special importance if one wants to use IR background radiation as a tracer for massive star formation.

2. MEAN ENERGY DISTRIBUTION OF BN-TYPE OBJECTS

There are two types of compact luminous IR sources: compact HII regions and radioquiet BN-type objects. Many of the BN-type objects seem to be younger than the compact HII regions (Henning and Gürtler 1986). However, it is possible that BN-type objects have lower luminosities than those of the compact HII regions. Model calculations by Cox, Krügel, and Mezger (1986) showed that dust in compact HII regions and near A- and B-type stars surrounded by dense gas can attain the warm dust color temperature, T_c, of 30–40 K (ν^2-efficiency from 50 to 1000 μm).

The energy distributions of compact HII regions were analyzed by Chini, Krügel, and Wargau (1987) and shown to be very uniform. To derive the energy distribution of the other type of contributors, we used the *IRAS* data of the PSCII for well-known isolated BN-type objects supplemented by near-infrared (NIR) and far-infrared data from the literature (for selection criteria and references see Henning, Pfau, and Altenhoff 1989, in press). In addition, we measured fluxes at 870 and 1300 μm at Pico Veleta (Pfau, Henning, and Chini 1989, in preparation). In Table 1, distances, bolometric luminosities, and color temperatures are given. The temperatures are taken from *IRAS* fluxes S(60) and S(100), assuming a ν^1 power law for the absorption efficiency $Q(\nu)$. These color temperatures of about 40 K are typical for BN-type objects and are similar to the temperature of WGDE. The relative contribution from BN-type objects and compact HII regions depends critically on the duration of their embedded

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TABLE 1. Average Energy Distribution for BN–Type Objects

Name	IRAS number	Dist. [kpc]	L_{bol} [$L_\odot$]	T_c (60/100) [K]
AFGL 490	03236+5836	0.9	2.6 E+3	≥45
AFGL 961	06319+0415	1.4	6.8 E+3	46
AFGL 989	06384+0932	0.8	3.3 E+3	37
AFGL 4176	13395-6153	4.0	≥1.4 E+5	41
AFGL 2059	18018-2426	1.5	2.0 E+4	37
12.4+0.5	18079-1756	2.3	2.0 E+4	38
W 33A	18117-1753	3.7	1.1 E+5	31
AFGL 2591	20275+4001	1.5	4.3 E+4	46
S 140-IRS1	22176+6303	1.05	3.0 E+4	43

phases.

The average energy distribution for BN-type objects is shown in Figure 1. This curve is broader than that for a single-temperature blackbody, indicating a wide range of dust temperatures. Longward of 60 μm, the mean energy distribution can well be represented by a modified Planck function with color temperature of 40 K, $Q(\nu) \propto \nu^1$ of up to 250 μm, and $Q(\nu) \propto \nu^2$ at longer wavelengths. In the region where the dust emission from the compact sources is important for the galactic background, the distribution is similar to that of the WGDE as given by CM, namely $\nu^2 B_\nu(T_c)$, with T_c of about 35 K.

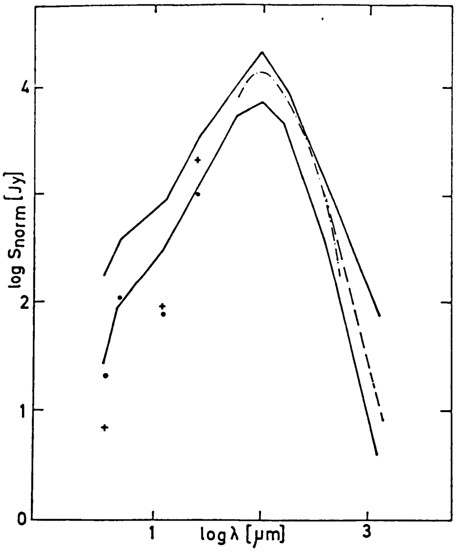

Figure 1. The average energy distribution of BN-type objects normalized to a total flux of 10^{-9} W m^{-2} is bounded by the heavy lines. NIR data points for W 33A (.) and 12.4+0.5 (+) are given separately because of the exceptionally deep 10 μm absorption. For the sake of comparison, the WGDE (dash-dotted line; after CM) and a modified Planck function (dashed line) are shown.

REFERENCES

Chini, R., Krügel, E., and Wargau, W. 1987, *Astron. Astrophys.*, **181**, 378.

Cox, P., Krügel, E., and Mezger, P.G. 1986, *Astron. Astrophys.*, **155**, 380.

Cox, P., and Mezger, P.G. 1989, *Astron. Astrophys. Rev.*, **1**, 49; CM.

Henning, Th., and Gürtler, J. 1986, *Astrophys. Space Sci.*, **128**, 199.

Henning, Th., Pfau, W., and Altenhoff, W. 1989, *Astron. Astrophys.*, in press.

Leisawitz, D., and Hauser, M.G. 1988, *Astrophys. J.*, **332**, 954.

Pfau, W., Henning, Th., and Chini, R. 1989, in preparation.