EMISSION FROM DUST NEAR HIGH-LATITUDE STARS

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1. INTRODUCTION

The spatial distribution of interstellar dust is clearly important in understanding not only galactic dynamics but also the processing of the dust and the interstellar medium in general. Probably the best spectral region for investigating interstellar dust is the infrared (IR), where the cool dust is likely to radiate. Indeed, one of the most prominent features of the *IRAS* sky is the ubiquitous cirrus emission, thought to be due to interstellar dust heated by the interstellar radiation field (ISRF), seen at 60 and 100 μm (Low 1984). However, it is difficult to use the cirrus to probe the dust distribution, both because we have no depth information and also because the cirrus, due to its low temperatures (~20 K), is a probe of high-density dust regions. A far more sensitive search could be made if the dust were hotter, that is, in the presence of a greater ultraviolet (UV) flux. We have made use of this fact to search for dust in the vicinity of hot, bright stars, where even a small amount of dust will dominate the total emission along that line of sight.

2. DATA ANALYSIS

The zodiacal light is a major contaminant in both the 60 μm and the 100 μm *IRAS* Sky Flux plates, and the first step in any procedure must be to remove it. We have made two assumptions in attempting to do this: (a) the 25 μm plate is composed almost entirely of zodiacal light, except for a few isolated regions; and (b) the brightness of the zodiacal light in the two long-wavelength plates is a constant multiple of the brightness in the 25 μm plate. We estimated these multiples by plotting the 60/25 μm and the 100/25 μm ratios and by fitting a baseline to them. We then fit the 25 μm image in the region of interest by a quadratic and subtracted this, multiplied by the appropriate constant of proportionality, from the 60 and 100 μm plates, respectively.

A major problem with this procedure is that the ratio of the 60 or 100 μm plate to the 25 μm plate does not appear to be constant over the plate for many regions, so it is difficult to establish a baseline. The ratio we select for a given plate is based on the lowest of these ratios and therefore we always underestimate the zodiacal correction and may leave residuals on the order of 2 MJy sr^{-1}. Although this is not important where there is a significant amount of cirrus or for hot stars, for cool stars in a cirrus-free region it may critically limit the quality of our results.

S. Bowyer and C. Leinert (eds.), The Galactic and Extragalactic Background Radiation, 237–238.

After the zodiacal light has been removed, our first-stage procedure is to place limits on the amount of dust that can be near a star. We use models for the stellar emission and for the optical properties of the dust to derive the 60 and 100 μm emission from the dust within a given distance of the star. We then reverse the procedure to place limits on the amount of dust that can be within that distance of the star by using the 60 and 100 μm *IRAS* Sky Flux plates.

3. RESULTS AND DISCUSSION

We have processed eight stars and our results are summarized in Table 1.

TABLE 1. Results

Star	*l*	*b*	Sp Type	Peak[a]	D(1 pc)[b]	D(2 pc)[c]
β Cep	108	14	B2III	no	0.48	1.3
δ Cet	171	−52	B2IV	no	1.9	3.2
η Hya	224	27	B3V	no	4.4	6.8
α Vir	317	51	B1V	yes	0.86	0.95
ω Sco	351	22	B0V	small	2.5	5.2
ν Sco	353	22	B1V	yes	14.9	38.3
β Sco	354	23	B0V	no	0.14	0.32
δ Sco	355	22	B2IV	yes	2.6	3.6

Notes: [a] presence of a peak in the 60/100 μm ratio at the star.
[b] the maximum average density possible inside a sphere of radius 1 pc centered on the star (H I cm^{-3}).
[c] the maximum average density possible inside a sphere of radius 2 pc centered on the star (H I cm^{-3}).

Even in this preliminary work, we have placed some very interesting limits for the amount of dust (expressed in terms of H I density) near a few of our observed stars, such as the 0.32 cm^{-3} within 2 pc of β Sco. Further and more profound interpretation will have to await the analysis of a greater number of stars (work now in progress).

4. CONCLUSIONS AND FURTHER WORK

We have demonstrated that we can use the *IRAS* Sky Flux plates to place rather stringent limits on the amount of dust near several hot stars. We plan to explore the regions around a large number of hot stars by using this procedure, which has been set up to require limited human interaction. At the same time, our program is very modular, which allows us to replace any part, such as our zodiacal light subtraction, without much effort.

Concurrently with this global effort, we also plan to model in some detail the dust in individual regions, a task that may prove impossible to automate. Thus, our final goal is to explore the global characteristics of the dust and to model the three-dimensional distribution in selected areas.

REFERENCES

Low, F. J., et al. 1984, *Ap. J. (Letters)*, **278**, L19.