CONTRIBUTION OF LINE EMISSION TO THE IRAS MEASUREMENTS: NGC 6853

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ABSTRACT. The contribution from the line emission of ions to the radiation at four IRAS bands has been estimated. The dust grains are likely to be mixed with ionized gas.

1. INTRODUCTION

NGC 6853, also known as the Dumbbell Nebula, has been investigated by Hawley and Miller (1978), Pottasch, Gilra and Wesselius (1982) and Barker (1984). The IRAS observations of it extend the wavelength coverage from the ultraviolet and visual to the far infrared part of the spectrum. Although dust grains are very efficient infrared emitters, the line emission of some abundant ions can also contribute to the infrared fluxes in the IRAS bands. The available detailed measurements of visual and UV lines make it possible to estimate the contribution from ions to all four IRAS bands with reasonable certainty.

2. DATA

The Dumbbell Nebula was measured by the SUR-AO's (Additional Observations with the survey array) and the CPC-AO's (Additional Observations with the Chopped Photometric Channel). The data of the two SUR-AO's and the two of four CPC-AO's of this nebula have been analyzed. The maps at the four IRAS bands deduced from SUR-AO's and the co-added CPC-AO's maps at 50 and 100 μm bands are obtained, and compared with the visual and radio maps (Bignell, 1986). The flux density and in-band flux for each survey band are given in Table 1. The 50/60 μm maps from CPC/SUR and the two 100 μm maps from CPC/SUR look very similar to the visual map and radio map at 20 cm from the VLA observation, but there are significant differences between 25 μm map and the maps at the other bands. The 25 μm map has a position angle of about 76° which is quite different from the values of less than 33° at other bands. And the FWHM sizes of the 25 μm map in both major and minor axes are smaller than those of the maps at other IRAS bands.

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3. CONTRIBUTION OF LINE EMISSION TO THE IRAS MEASUREMENTS

The infrared radiation from most planetary nebulae shows a very high excess over the continuous radiation expected from free-free emission. We have considered the possible contribution from line emission of ions to the radiation detected in the IRAS bands. The electron density and temperature in this nebula are chosen as $n_e \approx 200$ cm^{-3} and $T_e \approx 1.2\times10^4$ K (Pottasch, 1984). The total flux of the H_β line emission corrected for interstellar extinction is 4.46×10^{-10} ergs cm^{-2} sec^{-1} (Bussoletti et al., 1974).

We have taken into account the effect of the transmission function on the predicted fluxes of line emission in the IRAS bands. The total contribution of the related lines to the four IRAS bands, the IRAS fluxes after correction for line emission and the correction factors can be found in the fourth, fifth and sixth columns of Table 1.

As can be seen, the 25 μm radiation is dominated by the O IV 25.87 μm line emission. In fact, unlike O III, O IV radiation comes from a high ionization region, which must be in the inner part of the nebula. It is therefore to be expected that the 25 μm map dominated by the O IV 25.87 μm radiation would have a relatively smaller size and a different shape.

TABLE I. Flux densities measured at IRAS bands and corrected for line emission

λ (μm)	F (Jy)	F(in) (erg cm^{-2} sec^{-1})	F(line) (erg cm^{-2} sec^{-1})	F(corr) (Jy)	correction factor
12	8.2	$1.1\ 10^{-9}$	$7.5\ 10^{-10}$	2.6	68 %
25	41.1	$2.1\ 10^{-9}$	$1.5\ 10^{-9}$	11.0	75 %
60	135.2	$3.5\ 10^{-9}$	$9.6\ 10^{-10}$	97.7	28 %
100	206.3	$2.1\ 10^{-9}$	$4.6\ 10^{-10}$	160.0	22 %

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