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Far-infrared study of a few southern Galactic star forming regions

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Abstract. Simultaneous far-infrared observations at 130 and 200 μm of the southern Galactic star forming regions (associated with IRAS 12326-6245, IRAS 17059-4132, IRAS 17160-3707 & IRAS 17233-3606) have been carried out using the TIFR 100 cm balloon-borne telescope. These far-infrared maps have a resolution of $\sim$ 1 arc min and show extended emission. Nearly identical beams in the two far-infrared bands have enabled us to determine the dust temperature and optical depth distribution in the star forming regions. The TIFR bands are sensitive to the distribution of cold (< 30 K) dust. HIRES processed images in four IRAS bands at 12, 25, 60 and 100 μm and the mid-infrared images from the MSX mission at 8.3, 12.1, 14.7 and 21.3 μm have also been compared. Radiative transfer models have been explored to fit available observations (viz. SED, angular size, etc) to extract various physical parameters of these star forming regions.

The Galactic star forming regions associated with IRAS 12326-6245, IRAS 17059-4132, IRAS 17160-3707 & IRAS 17233-3606 have been mapped using the 12 channel two band far-infrared (FIR) photometer system at the Cassegrain focus of the TIFR 100 cm (f/8) balloon borne telescope. The observations were carried out during the balloon flight on 08/09 March, 1998 from Hyderabad in central India. Details of the instruments, observational procedure, image processing and analysis can be found in Ghosh et al. (2000). The achieved absolute positional accuracy is $\sim 0.'8$. As an example, the intensity maps in the two TIFR bands for the region around IRAS 17059-4132 have been presented in Fig. 1.

The data from the IRAS survey in the four bands (12, 25, 60 and 100 μm) for the a region $2^o \times 2^o$ centered around the IRAS sources were HIRES processed (Aumann et al, 1990) at the Infrared Processing and Analysis Center (IPAC). These maps have been used for extracting sources and quantifying interband positional associations and flux densities.

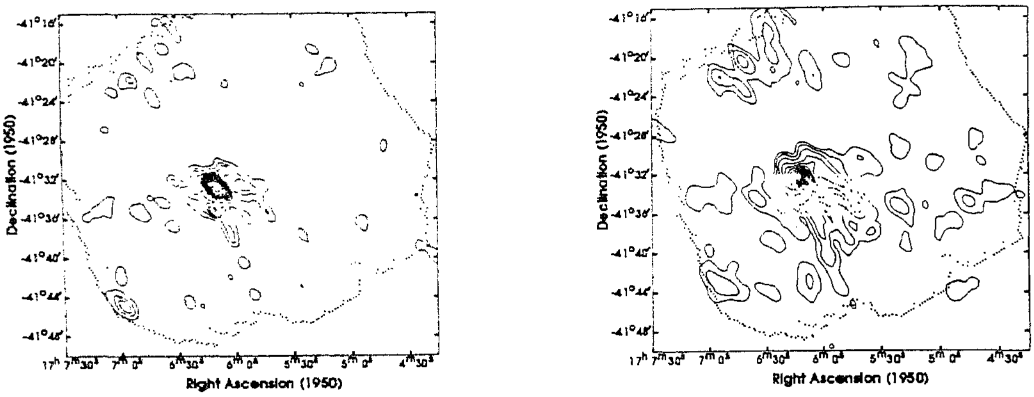

Figure 1. The intensity maps for the region around IRAS 17059-4132 in TIFR bands - (left) at 130 μm with peak = 3265 Jy/Sq. arc min, (right) at 200 μm with peak = 1257 Jy/Sq. arc min. The isophot contour levels are 95, 90, 80, 70, 60, 50, 40, 30, 20 & 10% (left) and 95, 90, 80, 70, 60, 50, 40, 30, 20, 10, 5 & 2.5% (right) of the respective peaks.

Taking advantage of the nearly identical circular beams of the TIFR bands and the simultaneity of observations, reliable maps of dust temperature, T(130/200), and optical depth (at 200 μm, τ_{200}) have been generated for the regions around IRAS sources. A dust emissivity law of $\epsilon_\lambda \propto \lambda^{-2}$ has been assumed for this purpose. Details of the procedure can be found in Mookerjea et al. (2000).

Self consistent radiative transfer calculations described in Mookerjea et al. (1999) have been carried out for these IRAS sources through spherical dust-gas clouds. The observed infrared sub-mm SED, angular sizes and the radio continuum data have been used to constrain the parameters of the models. The following parameters are explored in order to get an acceptable fit to all the data : (i) the nature of the embedded source, which could either be a single ZAMS star or a cluster of ZAMS stars consistent with the Salpeter Initial Mass Function; (ii) radial density distribution law (only three power laws have been explored, viz., $n(r) \propto r^\alpha$, with α = 0, -1 or -2; (iii) the relative abundances of the two constituent grain types (silicate & graphite); (iv) total radial optical depth due to the dust (inclusive of all constituents) at a selected wavelength (τ_{100} at 100 μm); (v) the gas to dust ratio by mass (the predicted radio continuum emission is sensitive to this); (vi) geometric details of the dust cloud (e.g. cavity size, outer size of the cloud).

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