Bull. Astr. Soc. India (1999) **27**, 155-158

Infrared emission from IRAS 00338+6312

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Abstract. The Galactic star forming region associated with IRAS 00338+6312 has been mapped in 2 Far Infrared (FIR) bands centered around 140 & 185 μm, using the TIFR 100 cm balloon-borne telescope with liquid ^{3}He cooled bolometer arrays. The results from these observations and the physical parameters derived from radiation transfer modelling of the source are presented.

1. Observations

Far infrared observation of the Galactic star forming region associated with IRAS 00338+6312 was carried out on 12th November, 1995, using the TIFR 100 cm balloon-borne telescope. Photometric mapping, of an area of $22' \times 7'$ was done simultaneously in 2 bands centered around 140 and 185 μm. The detector consists of bolometers cooled to a temperature of 0.3 K (using liquid ^{3}He) and divided into 2 groups, each having 6 detectors in a 3×2 configuration.

In addition, IRAS survey data of the region in four bands (12, 25, 60 & 100 μm) have been image processed by the Caltech processor HIRES and used here. Aperture photometry has been done on the Maximum Entropy processed TIFR images of IRAS 00338+6312 as well as on the HIRES processed IRAS images of the source to calculate the flux densities at these wavelengths. In addition to these, sub-mm flux densities from JCMT observations have also been used (McCutcheon et al., 1995). The VLA observations (McCutcheon et al., 1991) at 6 cm give an upper limit of 0.30 mJy for this source.

2. Modelling

The source IRAS 00338+6312 has been modelled by self consistent radiation transfer in gas and dust in spherical geometry. The code CSDUST3 (Egan et al., 1988) has been used for radiation transfer in dust and an additional algorithm has been incorporated for self-consistent radiation transfer in gas (pure hydrogen). A schematic of the spherically symmetric model is shown in Fig 1a. All available information about the source have been used as model inputs (Table 1).

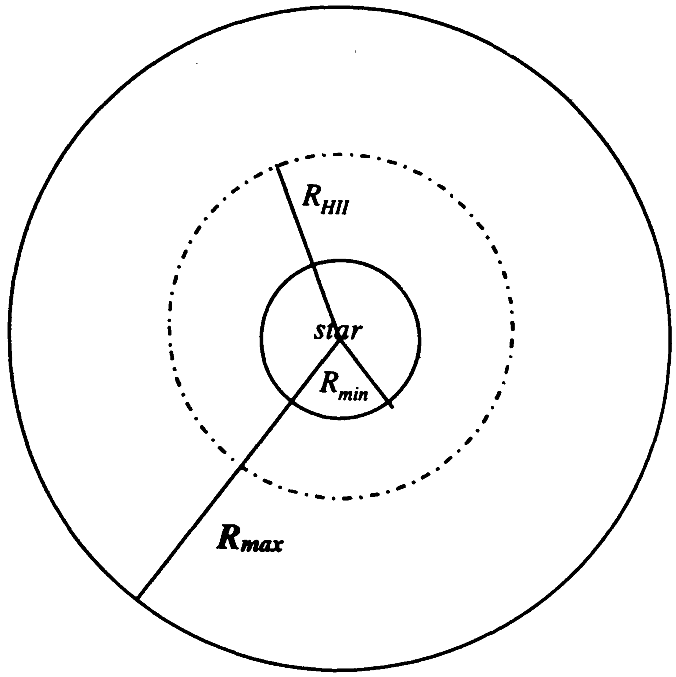

Figure 1a. Schematic diagram of the model

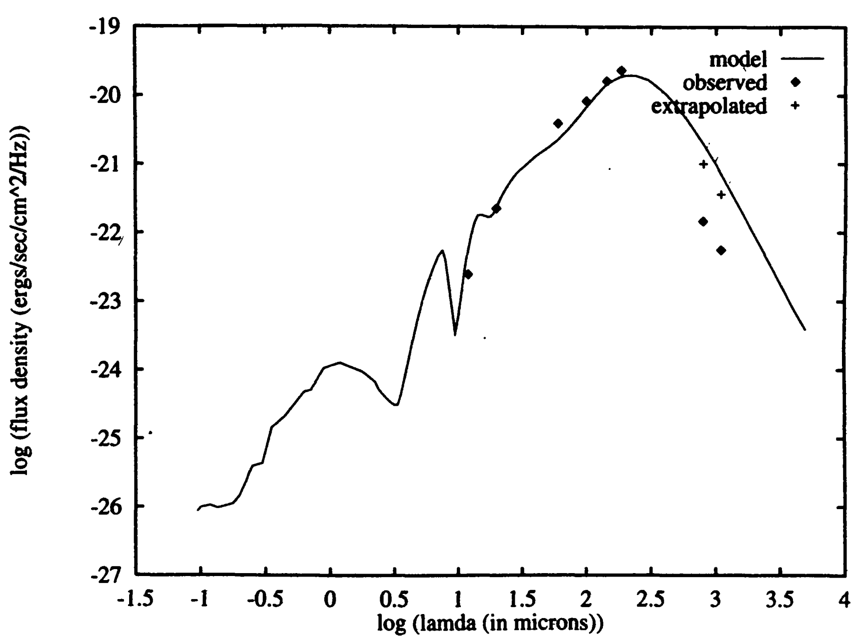

Figure 1b. Spectral energy distribution

The inner dust boundary (R_{min}) is determined by the sublimation temperature of dust. In the diagram R_{max} denotes the outer radius of the source, R_{star} denotes the distance from the star upto which, dust cannot exist, because of sublimation and R_{HII} denotes the extent of the HII region.

Table 1. Input Parameters & Model Outputs : a — for a gas to dust mass ratio of 50 : 1.

Parameters	From Observations	From Model
Radial distribution		r^0
Mass[a]	2.45×10^3 M$_\odot$	2.2×10^3 M$_\odot$
Luminosity	1100 L$_\odot$	1500 L$_\odot$
Distance	1.1 kpc	
Radial size	1.03 pc	1.1 pc
Colour temperature	36 K	
Stellar type	later than B2	B2.5
$\tau_{100\ \mu m}$		0.15
F_{6cm}	$\leq$ 0.30 mJy	0.330 mJy

The dust parameters fixed for all the models explored include : the types of dust (Astronomical Silicate and Graphite); scattering and absorption coefficients of dust (Laor & Draine, 1993); size distribution of dust grains ($n(a)\ da \sim a^{-3.5}\ da$) as taken from Mathis et al., 1977; the limits on the sizes ($a_{min} = 0.01\ \mu m$ & $a_{max} = 0.25\ \mu m$) of dust grains taken from Mathis et al., 1983 and the dust to gas mass ratio. In the different models explored we have varied the relative proportion of the 2 types of dust, the radial density distribution of dust (r^0, r^{-1} & r^{-2}) and the radial total optical depth $\tau_{100\ \mu m}$.

3. Results

Spectral energy distribution of the best fit model along with the observed data are shown in the Fig. 1b. This considers a ZAMS star of B2.5 type, embedded in a dust cloud of uniform density distribution. The models with r^{-1} & r^{-2} density distributions produce unacceptable spectral fits. The radio flux density at 6 cm is consistent with VLA observations. Different parameters for the best fit model have been compared with observations in table 1.

4. Conclusions

The observed spectral energy distribution of the star forming region IRAS 00338+6312, over a reasonably large range of wavelengths can be well explained in terms of a ZAMS star of type B2.5 embedded in a spherically symmetric and uniformly distributed cloud of dust and gas. The model is capable of treating the emission from dust and gas self-consistently as has been shown by the agreement of the observed radio emission with the calculated one.

References

Carpenter J. M. et al., 1990, ApJ, 362, 147.

Egan M. P., Leung C. M., Spagna G. F., Computer Physics Communications, 48, 271.

Laor A., Draine B. T., 1993, ApJ, 402, 441.

Mathis J. S., Mezger P. G., Panagia N., 1983, A&A, 128, 212.

Mathis J. S., Rumpl W., Nordsiek K. H., 1977, ApJ, 217, 425.

McCutcheon W. H. et al., 1991, AJ, 101, 1435.

McCutcheon W. H. et al., 1995, AJ, 110, 1762.