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Infrared study of the interstellar medium around IRAS 16164-5046 (RCW 106)

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Abstract. The spatial distribution of warm dust and emission in the Unidentified Infra-red Bands (UIBs) around RCW 106 have been studied using mid-infrared (MIR) measurements. Details of the interstellar medium in this region have been obtained from a self-consistent radiative transfer modeling (in spherical geometry) of observed Spectral Energy Distribution (SED). Using these best fit parameters, the luminosity in infrared features due to Polycyclic Aromatic Hydrocarbon (PAH) has been estimated using a simulation based on Cloudy. The predicted luminosity of PAH bands matches reasonably well (within a factor of two) with that inferred from MSX as well as direct observations from Spitzer-IRS.

1. Introduction

RCW 106 is a bright high-mass star forming complex in the southern Galactic plane (at d = 3.6 kpc with IRAS 16164-5046 as the prominent central source). The spatial distribution of the hot, warm and cold dust components around IRAS 16164-5046 has been obtained using MSX MIR bands (at 8.3, 12.1, 14.7 & 21.3 μm), *Spitzer* (24 & 70 μm) and TIFR far-infrared balloon-borne observations (150 & 210 μm) respectively. Geometric details, physical parameters and luminosity in the PAH bands have been extracted by two independent self-consistent approaches. Direct observations of the PAH features in the neighbourhood have been obtained from *Spitzer* IRS.

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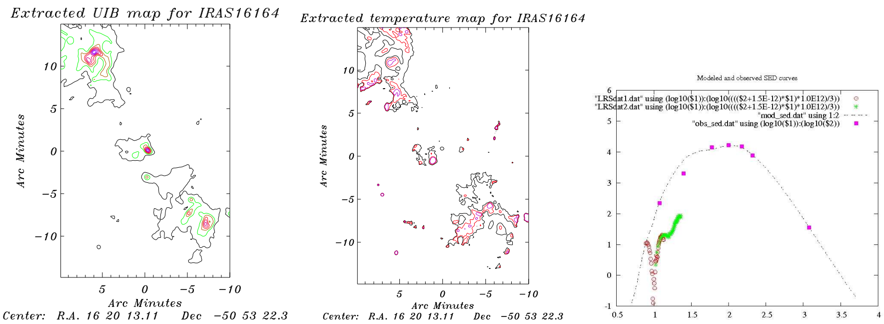

Figure 1. (*left*) Contours for UIB emission (at 90, 80, 70, 60, 50, 40, 30, 20, 10 % of the peak at $1.63 \times 10^{-4}\ Wm^{-2}Sr^{-1}$); (*middle*) T_d (at 125, 135, 145 K) & (*right*) best fitting model to the observed SED.

2. Spatial distribution of UIB/PAH emission

MIR (MSX) emission is modeled as a sum of gray body thermal emission from grains plus UIB emission from the PAH component of gas (Ghosh & Ojha 2002) to obtain spatial distribution maps of UIB features, temperature for the hot dust component and optical depth at 10 μm. The map for UIB emission & dust temperature T_d is shown in Fig. 1.

Table 1. Best fit model parameters.

Case	Radio Flux (843 MHz)	$M_c/M_\odot$ (Cloud mass)	R_c (Cloud radius)	Radius (Inner dust)	τ_{100}	Gas/Dust
Model	12.4 Jy	1.5×10^5	2.62 pc	0.32 pc	0.06	78

3. Modeling the observed SED

Radiative transfer modeling through a spherically symmetric cloud of pure hydrogen gas and dust, assuming Draine-Lee type grains, MRN grain size distribution and using the scheme of Mookerjea & Ghosh (1999), has been carried out to fit the observed SED (Fig. 1). The parameters for the best fit model are presented in Table 1.

4. Luminosity in PAH emission features

Using the above best fit parameters, simulation of complete ISM physics, including photoionization & thermal equilibrium, quantum heating, formation &

Table 2. Luminosity in PAH features within MSX A-band.

– –	Extracted from MSX	Spitzer-IRS Obsn.	Prediction of Cloudy simulation
L/$L_\odot$	15,934	33,000	6,897

destruction of molecular species, etc., has been carried out using the Cloudy code (C08). A comparison of the total luminosity in the PAH features (only those covered within the MSX A-band) obtained by spectroscopic observations of *Spitzer* IRS and inferred from the broad-band MSX data with those predicted by Cloudy simulation is presented in Table 2. The measurements from IRS have been corrected for the off-centric location of the slit (at 10% of the peak luminosity in MSX A-band).

References

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Mookerjea B., & Ghosh S. K., 1999, JAA, 20, 1