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Spatial distribution of Unidentified Infrared emission Bands in star forming regions

S.K. Ghosh* and D.K. Ojha

Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai (Bombay) 400 005, India

Abstract. Midcourse Space Experiment (MSX) has surveyed the Galactic plane in four infrared bands between 6 and 25 μm, two of which cover several Unidentified Infrared emission Bands (UIBs). A scheme has been developed to extract the spatial distribution of the UIB emission using the MSX data. The observations have been modelled by two components : (i) the emission in UIBs and (ii) an underlying thermal continuum (gray body) from the interstellar dust. The reliability of the scheme has been successfully verified by comparing the results for a sample of five Galactic compact H II regions (Sh-61, Sh-138, Sh-152, Sh-156, Sh-186) for which ISOCAM images in some individual UIBs are available. Our scheme demonstrates the usefulness of the MSX database for study of large scale spatial distribution of UIB emission (and the carriers of UIBs) in the entire Galactic plane.

Keywords : Infrared : Interstellar medium : lines and bands – Infrared : Interstellar medium : H II regions

The near to mid infrared spectrum originating from the interstellar medium of the Galactic star forming regions consists of various features in addition to a continuum. There exists a class of broad emission features, sometimes called "Unidentified Infrared emission Bands" (UIBs; at 3.3, 6.2, 7.7, 8.6, 11.3, 12.7 μm), identity of whose carriers and the emission mechanisms are still a subject of active research. The SPIRIT III instrument onboard Midcourse Space Experiment (MSX) satellite has surveyed the entire Galactic Plane ($|b| < 5^o$) in four mid infrared bands centered around 8.3 (A), 12.13 (C), 14.65 (D) and 21.34 (E) μm with an angular resolution $\sim$ 18" (Price et al. 2001). The MSX band

*e-mail: swarna@tifr.res.in

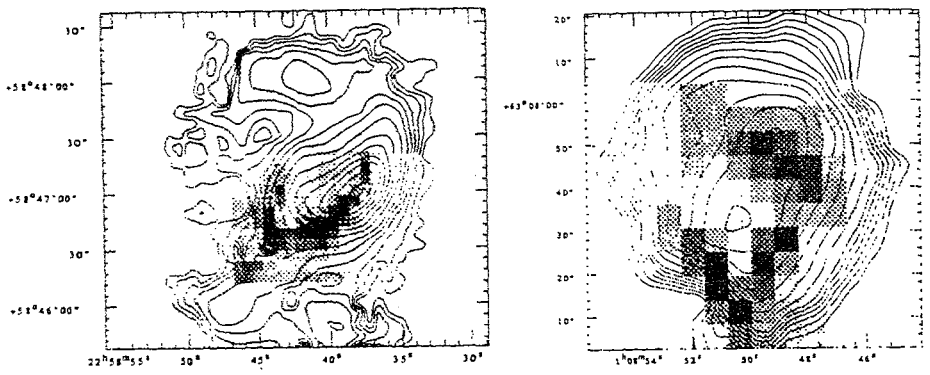

Figure 1. The spatial distribution of total radiance in Unidentified Infrared emission Bands (UIB_A) as extracted from the MSX maps (contours), for the regions around Sh-152 (left) and Sh-186 (right). The contour levels are at 99, 90, 80, 70, 60, 50, 40, 30, 25, 20, 15, 10 & 5% of the respective peaks (5.82×10^{-5} & $1.70\times10^{-5} W.m^{-2}.Sr^{-1}$ respectively). The ISOCAM data are overplotted in grey scale. The abscissa and the ordinate are R.A.(J2000.0) and Dec.(J2000.0) respectively.

A includes the dominant UIB features at 6.2, 7.7 and 8.7 μm. Similarly the MSX band C includes the UIB features at 11.3 and 12.7 μm.

The following scheme has been developed to study large scale emission in the UIBs in the Galaxy. Each pixel of MSX images has been modelled with an integrated emission in UIB features in the bands A and C (UIB_A, UIB_C) superposed on a gray body continuum spectrum characterized by the local dust temperature (T_d) and optical depth (τ). The best fit solution (for each pixel) provides a measure of the UIB emission locally.

The reliability of the scheme has been demostrated by comparing the results of five Galactic star forming regions, viz, Sh-61, Sh-138, Sh-152, Sh-156, Sh-186 which have been studied using the ISOCAM and whose emission in individual UIBs have been quantified (Zavagno & Ducci 2001). The comparisons for the regions Sh-152 and Sh-186 are presented in Fig. 1. In addition to the qualitative (e.g. structural details / morphology) similarities, a very strong quantitative correlation between the integrated estimate of UIB emission from our scheme and the ISOCAM results have been found.

References

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