Bull. Astr. Soc. India (2001) **29**, 337–338

Mapping of the Orion molecular cloud in the [CII] line and continuum at 158 μm

B. Mookerjea[1,2], S.K. Ghosh[1,3], H. Kaneda[3], T. Nakagawa[3], D.K. Ojha[1], T.N. Rengarajan[4], H. Shibai[4] and R.P. Verma[1]

[1]*Tata Institute of Fundamental Research, Mumbai 400005, India*
[2]*Joint Astronomy Programme, Dept. of Physics, Indian Institute of Science, Bangalore 560012, India*
[3]*Institute of Space and Astronautical Science, Kanagawa 229, Japan*
[4]*Dept. of Physics, Nagoya University, Nagoya 464, Japan*

Abstract. A fabry Perot Spectrometer (FPS) tuned to the astrophysically interesting (CII) line at 157.7409 μm, developed at ISAS (Japan) has been successfully interfaced to the TIFR 100 cm far-infrared balloon borne telescope. A region (30′ x 15′) of the Orion molecular cloud was mapped with a spectral resolution of 1700 and angular resolution of ~ 1′. The spatial distribution of (CII) line emission at 157.7409 μm and the neighboring dust continuum are presented here.

The fine structure line of singly ionized carbon (CII) at 158 μm together with the line due to neutral oxygen (OI) at 63 μm play a dominant role in cooling the molecular gas and account for nearly 1% of the cooling of a molecular cloud. Observations tracing these fine structure lines reveal information about the embedded sources, and due to their origin in the cloud/clump surfaces, about the structural details of the molecular cloud itself. A Fabry Perot Spectrometer (FPS) tuned to the fine structure line of (CII) at 157.7409 μm was installed at the focal plane of the Tata Institute of Fundamental Research (TIFR) 100 cm far-infrared (FIR) telescope. This was done to perform high angular resolution mapping of the [CII] line emission from extended star forming regions. Here we present observations of the Orion A region which are the **first** results from this combination of instruments.

The TIFR 1-m (f/8) FIR balloon-borne telescope has a cassegrain optics (Ghosh et al., 1988). The sky is chopped by wobbling the secondary mirror at 10 Hz with an amplitude of ~ 4.′5. The absolute positional accuracy of the FIR maps generated is ~ 0.′5. The FPS installed on the TIFR telescope is a modified version of that used earlier by Nakagawa et al. (1998) on the Japanese instrument, the Balloon-borne Infrared Carbon Explorer (BICE). The FPS on BICE was capable of mapping with an angular resolution of ~ 12′, while on the TIFR telescope the achieved angular resolution is ~ 1′5.

The new combination of instruments is capable of mapping a large area extending over 0°.5 x 0°.5 with an angular resolution of ~ 1′ and a spectral resolution of ~ 1700. Spectral scanning provides very reliable estimate of the continuum as well. Spectral scans which correspond to increasing and decreasing wavenumbers provide independent datasets useful to cross check the reliability.

Orion A was observed during the first flight of the FPS onboard the TIFR telescope on November 25, 1999. Jupiter was observed for the absolute flux calibration and Point Spread Function determination. The observation was done in the **Chopped Mode**, in which sky chopping, spatial and spectral scanning are all functional. The spatial scan rate was 0′.32 / sec and the frequency of spectral scan was 0.5 Hz.

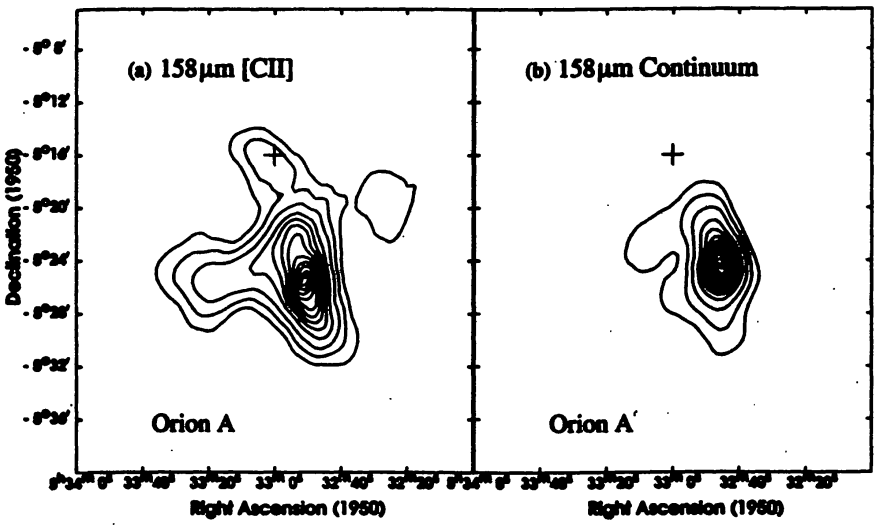

Figure 1. The intensity maps for (a) the [CII] line emission at 158 μm and (b) the dust continuum emission at 158 μm. Peak of the [CII] intensity map is 3.9 x 10^{-3} erg sec^{-1} cm^{-2} Sr^{-1} and that of the continuum is 4.76 x 10^{-3} erg sec^{-1} cm^{-2} Sr^{-1}. The contour levels are 95%, 90% to 10% in steps of 10%, 5% and 2.5% of the respective peaks. The sources marked with "+" are (1) BN/KL, (2) θ^1 Ori C and (3) M 43.

Fig. 1 shows the intensity map of the [CII] line emission as well as the dust continuum emission from Orion A at 158 μm. The peak of the [CII] map is close to the position of the trapezium stars and the peak intensity is 3.9 x 10^{-3} ergs sec^{-1} cm^{-2} Sr^{-1}. The total [CII] luminosity detected is ~ 50 $L_{\odot}$. The observations cover the HII region M43 as well and detect [CII] emission from the same. The peak of the continuum map is closer to the BN-KL region. The detected continuum features are very similar to those from earlier FIR observations by Mookerjea et al. (2000).

References

Ghosh S.K., Iyengar K.V.K., Rengarajan T.N., Tandon S.N., Verma R.P., Daniel R.R., 1988, ApJ, 330, 928
Mookerjea B., Ghosh S.K., Rengarajan T.N., Tandon S.N., Verma R.P., 2000, AJ, 120, 1954
Nakagawa T., Yui Y.Y., Doi Y., et al. 1998, ApJS, 115, 259