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DIFFUSE [CII] 158 MICRON LINE EMISSION FROM THE INTERSTELLAR MATTER AT HIGH GALACTIC LATITUDE

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ABSTRACT

We present the results of an rocket-borne observation of far-infrared [CII] line at 157.7μm from the diffuse interstellar medium in the Ursa Major. We also introduce a part of results on the [CII] emission recently obtained by the IRTS, a liquid-helium cooled 15cm telescope onboard the Space Flyer Unit. From the rocket-borne observation we obtained the cooling rate of the diffuse HI gas due to the [CII] line emission, which is $1.3\pm0.2\times10^{-26}\,ergs\,s^{-1}\,H_{atom}^{-1}$. We also observed appreciable [CII] emission from the molecular clouds, with average CII/CO intensity ratio of 420. The IRTS observation provided the [CII] line emission distribution over large area of the sky along great circles crossing the Galactic plane at $l = 50°$and $l = 230°$. We found two components in their intensity distributions, one concentrates on the Galactic plane and the another extends over at least 20° in Galactic latitude. We ascribe one component to the emission from the Galactic disk, and the another one to the emission from the local interstellar gas. The [CII] cooling rate of the latter component is $5.6 \pm 2.2 \times 10^{-}$

Key Words : Galaxies: ISM, Infrared: Spectra, Interstellar: Matter

I. A ROCKET-BORNE OBSERVATION

Far-infrared [CII] line at 157.7μm has been considered as a dominant coolant of diffuse interstellar medium. The observation of diffuse and weak [CII] line is, however, only possible from space. Here we present the results of an rocket-borne observation of the [CII] line from the diffuse interstellar medium in the Ursa Major, including the high latitude molecular clouds MBM 27 ~ 30 of Magnani, Blitz, & Mundy (1985). The observing instrument is a liquid He cooled telescope with a 2-channel spectrophotometer ($\lambda/\Delta\lambda \simeq 100$, 0.6°beam) onboard a sounding rocket , S-520-15, of the Institute of Space and Astronautical Science in Japan(details are described in Matsuhara et al. 1994).

As shown in Figure 1, from the correlation between the HI column density (N_{HI}) and the observed [CII] line intensity for both $N_{HI} < 2\times10^{20}\,cm^{-2}$ regions and regions with $W_{CO} < 0.2\,K\,km\,s^{-1}$*, we obtained the cooling rate of the diffuse HI gas due to the [CII] line emission, which is $1.3\pm0.2\times10^{-26}\,ergs\,s^{-1}\,H_{atom}^{-1}$(Bock et al. 1993, Matsuhara et al. 1996). We also observed appreciable [CII] emission from the molecular clouds, with average CII/CO intensity ratio of 420. We also found that the location of the [CII] emission peak is notably apart(~ 1°) from that of the CO.

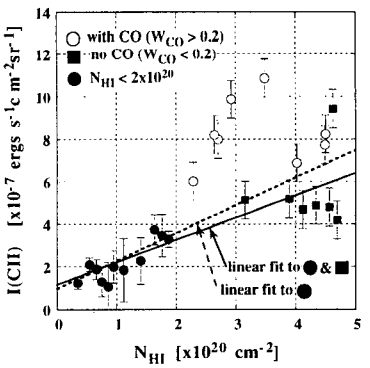

Fig. 1.— A plot of the [CII] 158μm line intensity vs. N_{HI}, obtained by the rocket-borne observation of the diffuse interstellar medium in the Ursa Major.

II. AN IRTS/FILM OBSERVATION

Details of the IRTS in-flight operation and its performance are described in Murakami et al. (1996), and details of the Far-Infrared Line Mapper(FILM) instrument is described in Shibai et al. (1994). The FILM observed the [CII] line with spectral resolution of $\lambda/\Delta\lambda \simeq$ 400 and $8' \times 13'$ beam. The observed area covers two strips along the two great circles: the north scan(close to the Galactic plane) and the south scan(crossing the Galactic plane at $b \sim 50°$and $b \sim 230°$).

From the analysis of subset(~0.5%) of the total data, we found two components in their intensity distribu-

*W_{CO} is velocity-integrated brightness temperature of the millimeter CO line, obtained by the Nagoya 4m telescope and by de Vries, Heithausen & Thaddeus (1987), which are then averaged in the beam of the rocket observation.

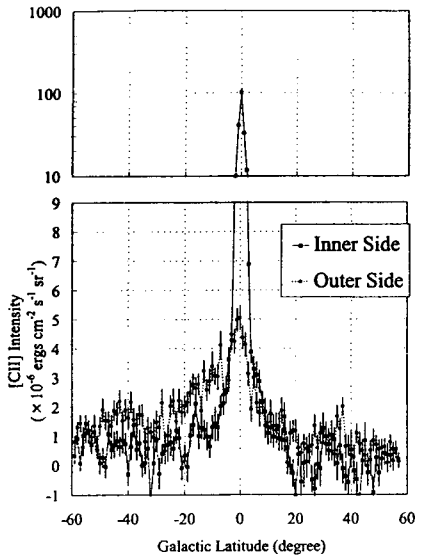

Fig. 2.— The intensity profile of the [CII] 158μm line emission along the scan path of the IRTS/FILM beam. Filled squares are the data points in the inner side of the Galaxy($l \sim 50°$) and filled circles in the outer side($l \sim 230°$).

tions, one concentrates on the Galactic plane and the another extends over at least 20° in Galactic latitude. We ascribe one component to the emission from the Galactic disk, and the another one to the emission from the local interstellar gas. The [CII] cooling rate of the latter component is $5.6 \pm 2.2 \times 10^{-27} ergs\ s^{-1} H_{atom}^{-1}$.

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