# OBSERVATION OF DIFFUSE CII EMISSION IN THE GALACTIC CENTER REGION

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ABSTRACT. Spectroscopic observations of CII line emission at 157.7 μm have been made of the Galactic Center region with a Fabry-Perot spectrometer onboard a balloon telescope. Strong emission has been detected ubiquitously in a wide area extending between ± 0.7° in galactic longitude. A ring-like structure is suggested from the double lobed distribution of the emission around the Galactic Center.

## I. INTRODUCTION

Carbon is one of the most abundant heavy elements in interstellar space and its far infrared line CII($^2P_{3/2}$ - $^2P_{1/2}$) at 157.7 μm is believed to be the most efficient coolant of interstellar clouds. It has a lower ionization potential (11.26 eV) than hydrogen (13.6eV) and thus easily ionized by low energy UV photons diffused out of HII regions.

The same photon can dissociate CO molecules, since its dissociation energy is almost the same as the ionization potential of the C-atom. Thus the ionized carbons would be most abundant in the transition region between HII-region and molecular clouds, forming a so-called CII region.

On the other hand, the excitation temperature of the CII line is relatively low (92K) and therefore it is easily excited by collisions in low temperature interstellar gas.

These facts suggest that CII regions would pervade a substantial part of interstellar space, particularly in the boundaries between HII regions and molecular clouds and the CII line would be emitted extensively in interstellar space.

CII emission has been found in a number of HII regions (Russell et al 1980, 1981, Kurtz et al 1983, Crawford et al 1985, Melnick et al 1986). These early observations already indicated



*M. Morris (ed.), The Center of the Galaxy, 145–149.*

that the emission regions are significantly extended. From recent observations of M17, Stutzki et al(1988) have claimed that CII emission is extended throughout the molecular cloud.

Detection of general emission in the galactic plane has been attempted by Stacey et al (1983) by using a lunar occultation, as well as the conventional chopping method (Stacey et al 1985).

As a general survey of the galactic-plane component, we have made observations of the CII line in the Galactic Center region; a preliminary analysis of the results will be reported in the following.

## II. OBSERVATIONS

The observations were made by using a Fabry-Perot spectrometer aboard a balloon-borne telescope. The Fabry-Perot spectrometer consists of a pair of two-stage tandem Fabry-Perot interferometers; one is tuned to the CII line at 157.7 $\mu$m, and the other to the OI line at 63.2$\mu$m. The spectral resolution of each interferometer is about 2500($\lambda/\Delta\lambda$) or 120 km/s in velocity. Both lines were observed simultaneously by using a beam splitter, but here we report only the results of the CII line. The whole system of the spectrometer, including the optics, F-P etalons, as well as detectors, were all cooled by liquid Helium at 2K. This has greatly enhanced the detectivity of the Ge-Ga photoconductors with reduced background radiation.

The balloon telescope has an aperture of 50cm and a beam size of 3.6'. The beam is chopped by means of a secondary mirror wobbled with a throw of 16' at 8Hz. The telescope attitude is controlled by an offset guiding system and its pointing accuracy was 10" in rms throughout the observations.

Two balloons were flown from the NSBF at Palestine Texas on May 24 and June 4, 1988.

The points observed in the two flights are shown in Fig.1, superimposed on the far infrared continuum map made by Odenwald and Fazio (1984). 45 points were sampled in the region between $-0.7^\circ$ and $+0.7^\circ$in galactic longitude, mostly along the galactic plane, and along two parallel lines adjacent to the galactic plane.

The wavelength of the spectrometer was scanned over a velocity range of $\pm$ 600km/s in 8 seconds and 8 scans were accumulated for each observing point.

## III. OBSERVED RESULTS AND DISCUSSION

Strong line emission has been observed at every point of the observations. Some examples of line profiles are displayed in Fig. 1, showing sampling at several points on the galactic plane.

The observed lines are clearly resolved and Doppler deviation from the LSR velocity is easily recognized. From the observed profiles, an L-V diagram has been constructed and shown in Fig.2.

The line width in the Galactic central region is very broad, extending $\pm$100km/s. This is consistent with the results obtained for the central few arc minutes by Lugten et al (1986). The galactic rotation is clearly seen, but the velocity is a little higher on the negative longitude side than on the positive side.

https://doi.org/10.1017/S0074180900186449 Published online by Cambridge University Press

The general tendency of the velocity variation is similar to that obtained in CO observations (Bally et al 1987).

The most interesting is that the line intensity peaks at two positions almost symmetrical with respect to the Galactic Center. This is clearly seen in Fig.3, where the integrated line intensities are plotted as a function of galactic longitude.

This behavior is quite different from the continuum emission near the line which has been estimated from the offset levels of the spectral profiles. The continuum intensity apparently peaks at the positions of Sgr B2, Sgr A and an anonymous source near l=-0.3°, while the line intensity peaks almost corresponding to Sgr Bl and Sgr C. The line intensity is not correlated with low temperature dust emission,but has a better correlation with the intensity distribution of shorter wavelength emission of dust such as given in the map of Odenwald and Fazio(1984).

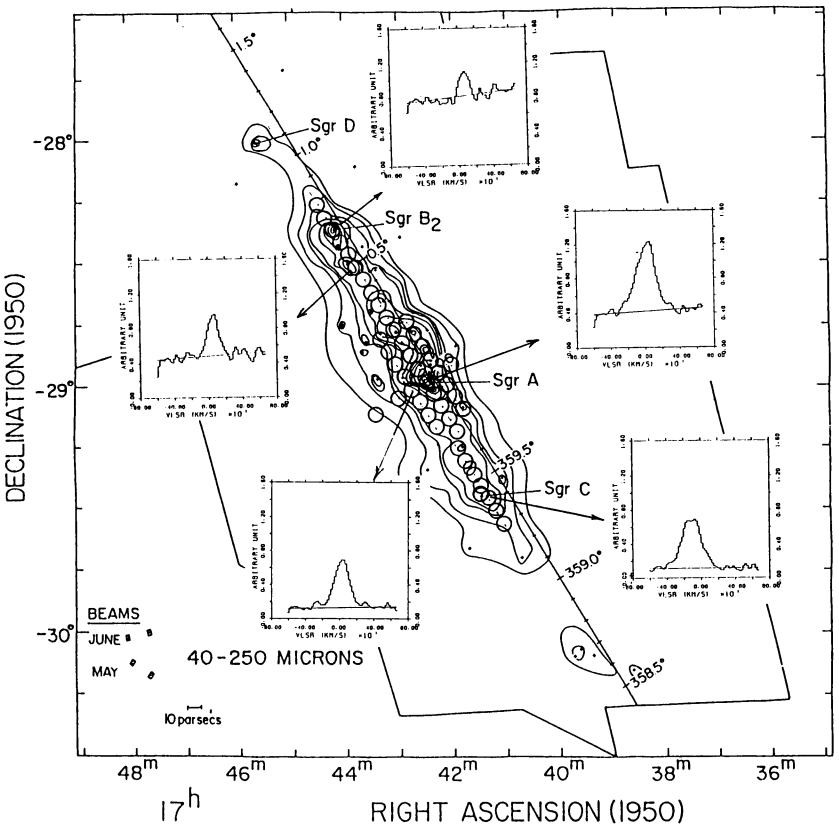


Fig. 1 Observed points of CII line spectrum plotted on the far infrared map by Odenwald and Fazio(1984). Several examples of the observed spectra are also shown at typical positions

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The symmetrical distribution of the CII emission could be accidental, but it may suggest the emission may be generated in a ring around the Galactic center.

Another interesting thing is that we can see an enhancement in the positive longitude side of the Sgr A peak. This apparently corresponds to the thermal radio bridge found in the VLA observation by Yusef-Zadeh et al (1987). The correspondence has been more clearly shown in the detailed mapping of CII emission in this area by Genzel et al (1988).

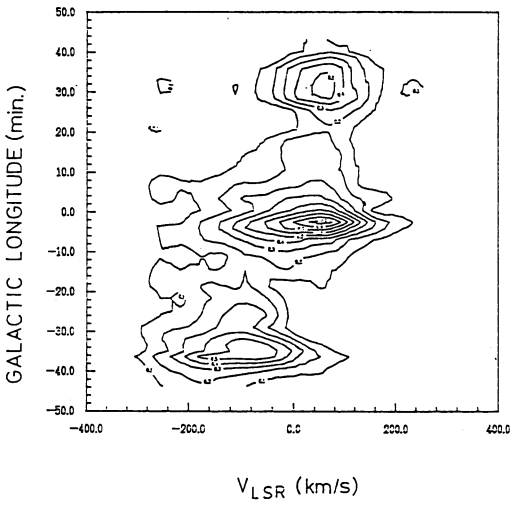


Fig. 2 L - V diagram of the CII line in the Galactic center region

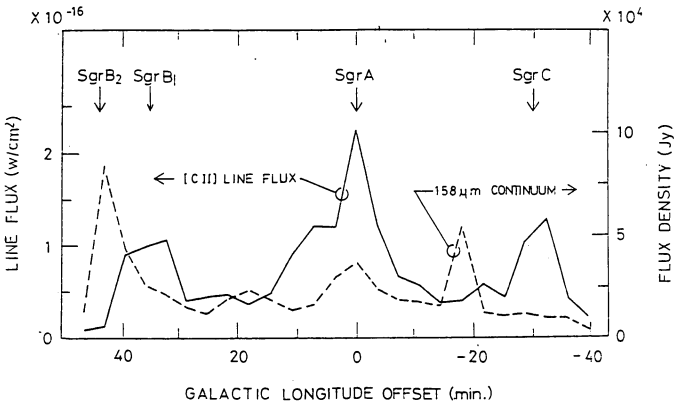


Fig. 3 Galactic longitude distribution of the CII line intensity and continuum intensity near the line

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## IV CONCLUSION

Strong diffuse emission of the CII line has been observed in the Galactic central region. The behavior of the intensity distribution is similar in general but different in detail from the far infrared continuum or radio CO emission. This means that observations of the CII line would add new and valuable information for studies of interstellar chemistry, physics and dynamics.

This work was done as Japan/US Science Collaborative Experiments and supported by grants of Misistry of Education, Japan Society for Science Promotion and NSF of USA.

We are grateful to the staff of NSBF in Palestine Texas for their assistance in the balloon flights.

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