RADIO OBSERVATIONS OF THE GALACTIC PLANE CH DISTRIBUTION

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ABSTRACT

The CH distribution in the galactic plane has been determined through observations of the ground state main line transition $^2\Pi_{1/2}$, J=1/2,F=1-1 at 3335 MHz. The longitude ranges $10^o \leq \ell \leq 60^o$ and $60^o < \ell \leq 230$ have been covered with the spacings 2°5 and 5°, respectively. The derived radial distribution is similar to that of CO, although differencies may exist. From observations at $\ell=30^o$ and 43°26 the CH layer halfwidth is estimated to be 50 pc, in close agreement with that of CO. A CH displacement below the standard plane is observed in these directions.

INTRODUCTION

Radio observations of the three hyperfine transitions in the $^2\Pi_{1/2}$,J=1/2 ground state of CH have shown that this radical is widespread in the Galaxy and generally behaves like a weak maser(see e.g.Rydbeck et al., 1976; Hjalmarson et al.,1977 and references therein).The negative excitation temperature observed is believed to be a fundamental property of interstellar CH; collisions with H and H_2 is the likely net inversion mechanism of the Λ-doublet. No significant difference in the main line excitation temperature is observed in clouds of varying density.Furthermore, since CH shows weak maser characteristics the column density determination is quite insensitive to variations in the excitation temperature in the case of moderately strong continuum background radiation(Hjalmarson, et al.,1977). These properties of CH make it a useful tool to investigate the interstellar matter of the Galaxy and a complement to the CO surveys which reveal very cool and dense regions. CH surveys presumably trace the more diffuse constituents of the Galaxy, since this reactive radical most likely is tied up in heavier molecules in the densest regions.

EQUIPMENT, OBSERVATIONS AND DATA REDUCTION

The survey was carried out at 3335 MHz(the CH main line)with the 25.6 m radio telescope of Onsala Space Observatory during spring-fall 1977 and spring 1978. The telescope was equipped with a TW-maser giving a system

W. B. Burton (ed.), The Large-Scale Characteristics of the Galaxy, 57–60.

noise temperature in the range 30-35 K. The HPBW is 15 arcmin and the beam efficiency is 0.6. The backend used consists of a 100 channel filterbank with a frequency resolution of 10 kHz(the total velocity coverage is 90 km s^{-1} at 3335 MHz).

The galactic plane was covered in the longitude ranges $10^o \leq \ell \leq 60^o$ and $60^o \leq \ell \leq 230^o$ with a spacing of 2.°5 and 5^o, respectively. The typical integration time of each spectrum is 5 hours. In addition, the local spiral arm was traced from $\ell=69^o$ to $\ell=87^o$ with an interval of 1^o. Observations out of the galactic plane have been performed at three longitudes so far: $\ell=30^o$, ℓ=43.°26 (W49 region) and $\ell=71^o$(the local spiral arm). The observations in the W49 area are an extension of the earlier observations by Sume and Irvine (1977).

Low order (not greater than two) polynomial baselines have been removed from the raw spectra. Since each spectrum just covers 90 km s^{-1} in velocity, the polynomial fitting process introduces some baseline uncertainties in spectra of broad, weak features. Thus we can not rule out the possibility that features of this kind are lost.

THE LONGITUDE VELOCITY DISTRIBUTION

The observed CH antenna temperatures are displayed in a longitude velocity diagram in Fig.1. Due to the insufficient velocity coverage of the filterbank, the spectra were essentially centered to cover allowed velocities according to the Schmidt rotational model. For ℓ>37.°5 the velocity coverage is 90 km s^{-1}, for $\ell \leq$37.°5 it is about 160 km s^{-1}.

The CH longitude-velocity diagram is similar to those obtained for CO (Burton and Gordon,1978) and diffuse ionized hydrogen(Lockman,1976) in that most emissions originate from regions inside the solar circle and lacks significant high velocity components for $\ell<25^o$.

THE RADIAL DISTRIBUTION

The radial distribution of CH has been determined with the aid of the rotational curve obtained by Burton and Gordon (1978). In deriving the CH density, equation (7) in the paper by Rydbeck et al.(1976) was used. The excitation temperature was assumed to be -10 K and effects of clumping were neglected. The relative positions in the line of sight of the CH clouds and the discrete continuum sources are in most cases impossible to determine. Therefore, the radial distribution of CH(Fig.2) is derived for the two extreme cases: the discrete sources are supposed to be located in front of (1) and behind (2) the CH gas, respectively. The continuum contribution has been estimated from the 2.695 GHz map of Altenhoff et al.(1970). As seen from Fig. 2, the CH and CO maxima coincide. However, there is a lack of CH inside the 4 kpc ring and the fall off towards larger distances is not as steep as in the CO case. Whether these differencies are real or not is an open question. The apparent lack of CH at small distances may simply be due to the previously mentioned baseline uncertainties. The CH excess at larger distances could possibly

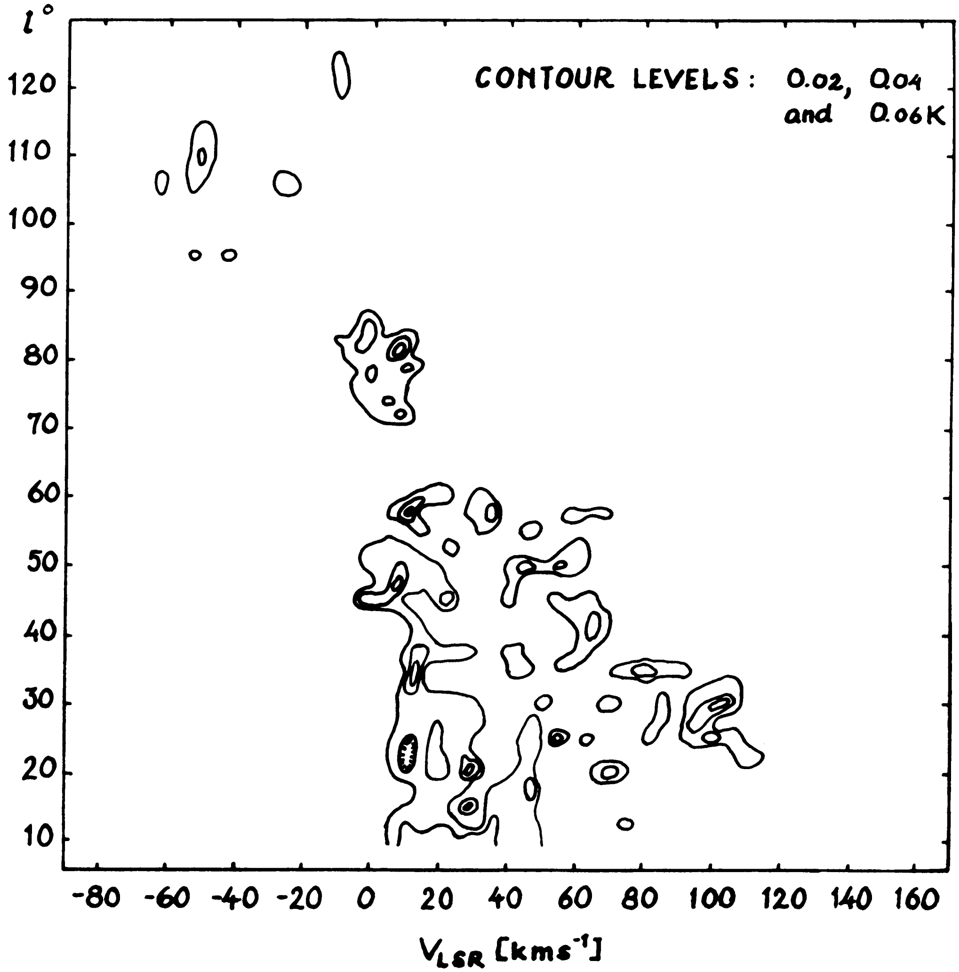

Fig. 1. Longitude velocity diagram of the CH antenna temperatures.

indicate a tendency for CH to follow the large scale HI distribution.

THE DISTRIBUTION PERPENDICULAR TO THE GALACTIC PLANE

The latitude velocity diagrams of the antenna temperatures for $\ell=30^{\circ}$ and $43\overset{\circ}{.}26$ are displayed in Fig.3. Using the high velocity features we have estimated the CH layer halfwidth $z_{1/2}$ and the displacement z from the standard plane to be $z_{1/2}=50\pm10$ pc, $z=-35\pm10$ pc at $\ell=30^{\circ}$ and $z_{1/2}=45\pm15$ pc, $z=-65\pm25$ pc at $\ell=43\overset{\circ}{.}26$. These numbers are corrected for beam broadening; the errors include uncertainties due to noise fluctuations, continuum background and in the case of $\ell=43\overset{\circ}{.}26$, the kinematic distance ambiguity. From Fig. 2 in the paper by Cohen and Thaddeus (1977) we get the corresponding numbers for CO: $z_{1/2}=50$ pc, $z\approx0$ pc for $\ell=30^{\circ}$ and $z_{1/2}=50$ pc, $z=-40$ pc at the subcentral point of $\ell=43\overset{\circ}{.}26$. We thus may conclude

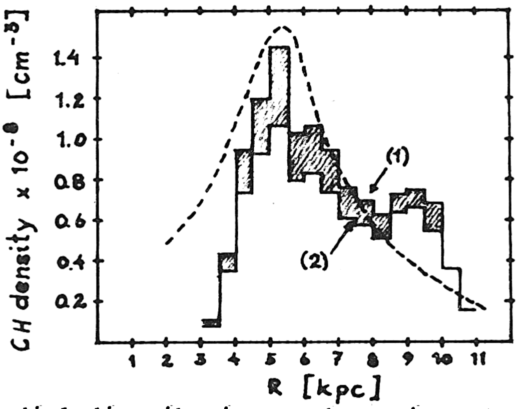

Fig. 2. The CH radial distribution as determined for the two extreme cases (1) and (2)(see text). The relative CO density distribution is shown by the dashed curve(Burton and Gordon,1978).

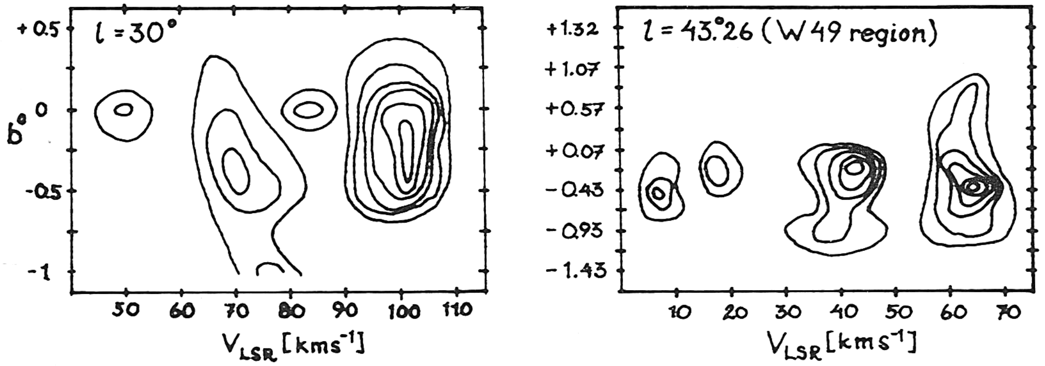

Fig. 3. Latitude velocity diagrams of the CH antenna temperatures for $\ell=30^{\circ}$ and 43°26. Contour levels are 0.01(0.01)0.06 K.

that the CH distribution perpendicular to the galactic plane resembles that of CO but differs significantly from the HI distribution in this respect.

A more detailed analysis of the CH data will appear in a forthcoming scientific report from the Onsala Space Observatory.

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