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Molecular, Atomic and Ionized Gas towards Cas-A

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Abstract. We present a comparison of the spatial distribution of molecular gas (as determined from ^{12}CO, $J = 1 \rightarrow 0$ line), atomic gas (as determined from 21 cm HI absorption) and ionized gas (as observed in C270α recombination line) towards Cas A.

Key words: Radio sources: Cas A—Radio Lines: Molecular, HI, recombination lines—ISM: Ionized carbon

1. Introduction

Recombination lines from highly excited Rydberg levels (principal quantum number $n \sim 300$–700) of carbon have been detected in a number of directions. The best studied direction at various frequencies is that of the strong radio source Cas A whose line of sight intersects the Perseus and Orion arms. Though carbon recombination lines at low frequencies have been detected in many directions, it is still not clear whether the lines are associated with HI regions or molecular clouds (Payne *et al.* 1989). As a step towards resolving this question we present here a comparison of the spatial distribution of ionized carbon observed in C270α recombination line with that of atomic gas observed in HI (21 cm) absorption line and the molecular gas observed in ^{12}CO ($J = 1 \rightarrow 0$) emission line towards the direction of Cas A. Cas A being a strong background source provides a spatial cutoff for the HI absorption and thus the study can be confined to the extent of Cas A.

2. Observations

The ^{12}CO observations were made with an angular resolution of $\sim 1'$ using the 10.4 m telescope at the Raman Research Institute. Chopper wheel method was used for temperature calibration and frequency switching was employed for baseline correction. The spectrometer was a 256 channel filter bank of 250 kHz contiguous filters. The double sideband system temperature varied between 1000–1800°K depending on the weather. The C270α (332.7 MHz) observations were carried out at VLA in its C and D configurations which gave an angular resolution of $\sim 2.7' \times 2.4'$. For the distribution of atomic gas, we have used the HI data obtained using the

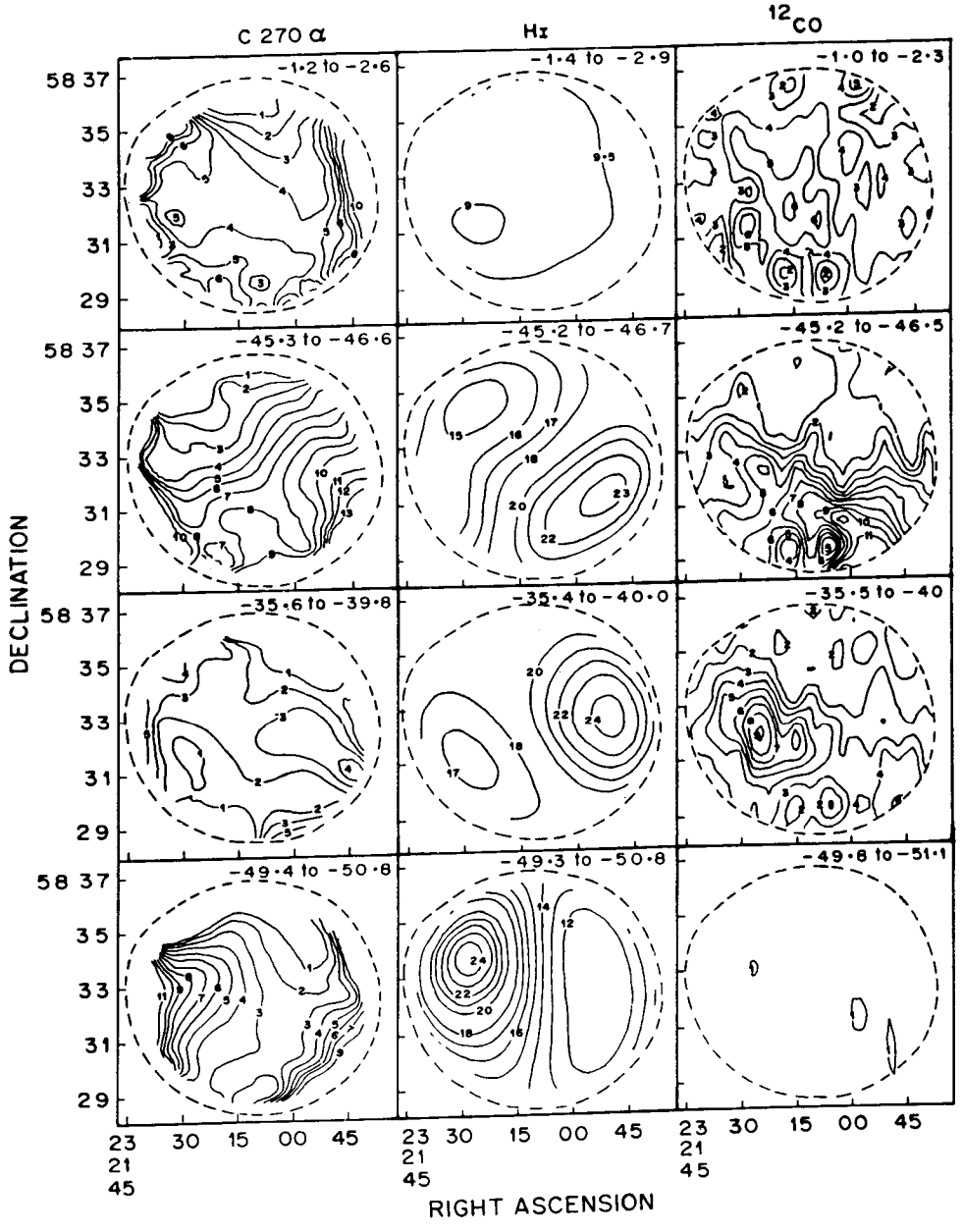

Figure 1. Spatial distribution of optical depths of C270α recombination line and 21 cm HI absorption lines and antenna temperature (T_A^*) of ^{12}CO emission over the face of Cas A at four different velocities. The velocity range is indicated in each frame in km s^{-1}. Contour units are C270α: 10^{-3}; HI:0.1; and ^{12}CO:0.3°K.

Westerbork Synthesis Telescope by Kalberla *et al.* (1993). The HI data was convolved to the resolution of C270α observations. The spectral resolution in all these observations is ~ 1.5 km/sec.

3. Results

The observed distribution of C270α, HI and ^{12}CO over the face of Cas A is presented in Fig. 1 for four velocity ranges. The top frame corresponds to the Orion arm and the other three to the Perseus arm clouds. It is clear from Fig. 1 that the distribution of C270α is very similar to that of HI rather than molecular gas. This association makes it possible to construct a model in which several physical properties of the clouds can be determined by combining the recombination line and 21 cm HI measurements. Such model calculations have been recently presented by Payne *et al.* (1993).

References

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