The HI content of the W80 dark cloud on scales from 20 to 0.3 pc

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The dark cloud between the North America and Pelican Nebula has been mapped in HI using DRAO synthesis telescope at Penticton, B.C.(Canada) and the 100m telescope at Effelsberg (MPIfR Bonn, F.R.G.) for the short baselines. The angular resolution is 2'= 0.3 pc, assuming 500 pc for the dark cloud distance (Strayzis et al. 1989, Wendker et al. 1983).The spectral resolution was 1.3 km/s. The main part of the dark cloud has been mapped also in the CO (J=1-0) line with the 3m telescope on the Gornergrat (KOSMA, Switzerland) with resolutions of 3.8' and 0.6 km/s.
The distribution of HI emission is far from homogenous. The line maps are dominated by irregular patches of up to 10 pc size and systems of filaments up to 20 pc size with substructure down to 1 pc.
At radial velocities associated with that of the dark cloud, the HI emission tends to outline the shape of the bulk of the molecular gas seen in the CO data. It could be regarded as the outmost layers of the dark cloud, in which the molecular hydrogen is dissociated by the interstellar radiation field and especially by the ionizing star(s) of the nearby HII region.
The appearance of the cold HI seen in self-absorption against the warm galactic HI background is in significant contrast to the emission properties mentioned above. There are several well-defined regions of HI in self-absorption often being in good correlation with high CO line emission at the same velocity. The scale sizes of the cold HI gas range from 5 pc down to the resolution limit of 0.3 pc (Fig.1).
We cannot distinguish between clumps of different sizes and a group of small equally sized clumps with a variable number density.
The properties of the cold HI are: Spin temperature ca. 10 K (from CO kinetic temperature), optical depth 0.3 - 0.6, column densities 1 to 5 x 10^19 cm^-2, volume densities 5 - 10 cm^-3, and estimated masses 0.1 - 5 M(sol).
The correspondence of HI self-absorption and CO emission in position and velocity (Fig.2,3) indicates that the atomic and molecular gas should be well mixed and result from incomplete HI to H2 conversion.

References:

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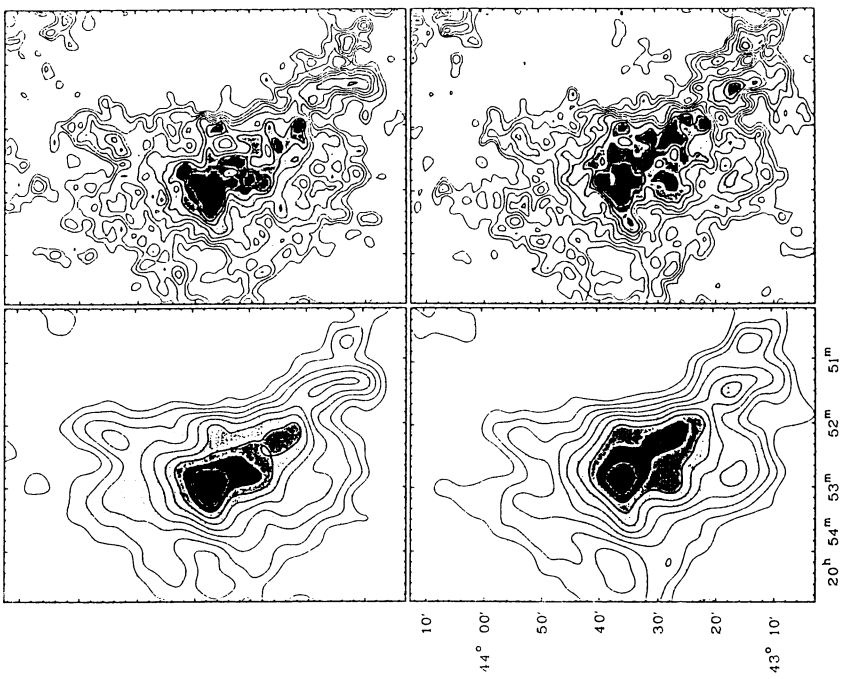
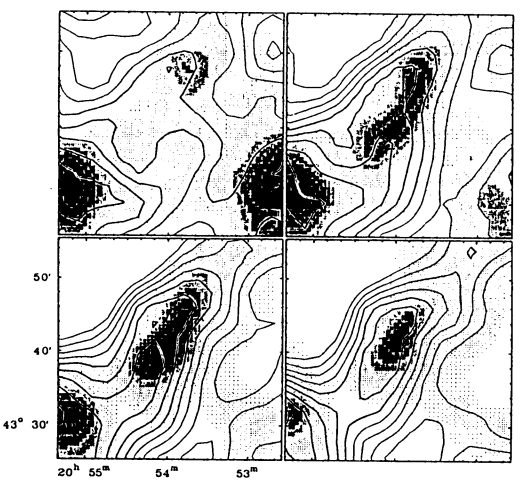
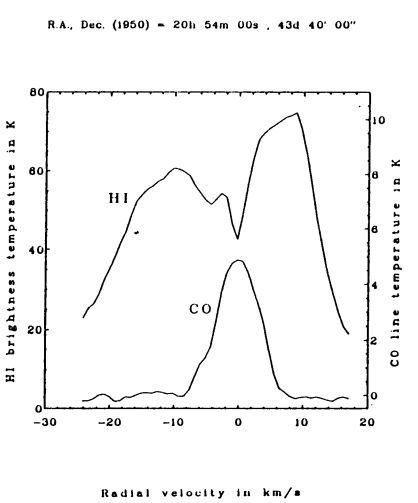


1.) The substructure of an HI self-absorption region within a dark cloud
Left : Line maps at 4' (ca. 0.6 pc) resolution
Right: Line maps at 2' (ca. 0.3 pc) resolution
The line maps were taken at velocities of 3.9 and 3.1 km/s.
Transition values are from −20 K (black) to −4 K (white) by steps of 3 K relative to the map average.



2.) A region of HI self-absorption (grayscale) with superimposed contours of CO line emission at different velocities (1.4, 0.6, −0.2, and −1.0 km/s). Angular resolutions: 4' (HI) and ca. 3.8' (CO).
Grayscale transitions : −20 K (black) to −4 K (white) by 2 K
Contour values: 2 K to 6 K by 0.5 K



3.) An example for the correlation of HI self-absorption and CO line emission in the W80 dark cloud.

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