

# **Revisiting the Vertical Distribution of HI Absorbing Clouds**

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The three-dimensional distribution of neutral hydrogen in the Milky Way disk is a key constraint on models of Galactic spiral structure, galaxy evolution, and star formation. In particular, the vertical distributions of the different phases of hydrogen (ionized, warm neutral, cold neutral, and molecular) inform our understanding of the evolution of gas between these phases. Although the scale height of the HI emission disk has been well-characterized across the Galaxy, the vertical distribution of the cold HI component is significantly more challenging to constrain due to the sensitive absorption observations required to characterize this phase. Almost four decades ago, Crovisier (1987) pioneered a kinematic method to estimate the vertical distribution of cold HI clouds in the solar neighborhood using the latest results from the Nancay 21-cm absorption survey. This method was subsequently used in other studies to constrain the vertical distribution of neutral and molecular clouds. We have discovered an error in Crovisier's method that can lead to a factor of two inaccuracy in the inferred scale height. We will discuss the mistake and, using the original Nancay data and a corrected method based on Crovisier's technique, demonstrate the magnitude of the error in the inferred scale height of the local cold HI disk. Furthermore, we will introduce a new Monte Carlo Markov Chain method to infer the vertical distribution of HI absorbing clouds with fewer assumptions and better accuracy. This method will be used with the latest HI absorption data from the Galactic ASKAP HI survey of the Milky Way disk to provide an unprecedented view of the 3D distribution of the cold neutral medium in the solar neighborhood.