A Survey for Infall Motions toward Starless Cores. I. CS (2-1) and N_2H^+ (1-0) Observations

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We present the first results of a survey of 220 starless cores selected primarily by their optical obscuration (Lee & Myers 1998), in lines of CS(2-1), N_2H^+ (1-0), and $C^{18}O$ (1-0) using the NEROC Haystack 37-m telescope. We detected 163 of 196 sources in CS, 72 of 142 in N_2H^+ and 30 of 30 in $C^{18}O$. In total, 69 sources were detected in both CS and N_2H^+.

A significant fraction of the CS spectra shows self-absorbed features that appear related to high optical depth and kinematical effects, while the isolated component (F_1F=01-12) of the N_2H^+ line usually shows a weaker symmetric profile which is optically thin.

The distribution of normalized velocity difference (δV_{CS}) between CS and N_2H^+ peaks is significantly skewed to the the blue ($\delta V_{CS} < 0$), as was found in a similar study of dense cores with embedded YSOs (Mardones et al. 1997). This incidence of sources with blue asymmetry tends to increase as the total optical depth or as the integrated intensity of the N_2H^+ line increases. Our sample contains many more ''blue'' sources than "red" sources, suggesting that inward motion is a significant feature of starless cores. We identify 7 strong infall candidates and 10 probable infall candidates. Their typical speeds of inward motion are subsonic, approximately 0.04 - 0.1 km s^{-1}, and they are in 'thermal' infall motions, unlike faster speeds associated with most YSOs (Mardones et al. 1997).