THE SUBMILLIMETER-WAVE SPECTRUM OF THE CrH AND CrD ($^6\Sigma^+$) RADICALS

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The N = 0 $\rightarrow$ 1 transition of CrH and the N = 1 $\rightarrow$ 2 line of CrD in their $^6\Sigma^+$ ground states have been recorded using sub-millimeter direct absorption techniques. This study was the first direct measurement of these transitions. These molecules were produced in a discharge plasma of chromium vapor and H_2 or D_2 gas. Three fine structure components were measured for each radical, and the proton and deuteron hyperfine splittings were also resolved. Spectroscopic constants were obtained by fitting the data with a Hund's case (b) Hamiltonian including rotation, spin-rotation, spin-spin, magnetic hyperfine, and electric quadrupole interactions. These measurements have resulted in improved spectroscopic constants for both isotopomers. The hyperfine parameters suggest that the bonding in CrH has a nonnegligible covalent character. This molecule may be present in the outer envelope of late-type stars and formed by ion-molecule reactions from neutral or ionized Cr and hydrogen gas. Chromium has a cosmic abundance of Cr/H = 5 x 10^{-7}.