DIRECT MEASUREMENTS OF THE FUNDAMENTAL ROTATIONAL TRANSITIONS OF CD AND $^{13}$CH ($X^2Π_g$)

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The $N = 1 \rightarrow 1$ and $N = 1 \rightarrow 2$ rotational transitions of CD, and the $N = 1 \rightarrow 1$ lines of $^{13}$CH have been measured in their $^2Π_g$ ground electronic states using sub-mm direct absorption spectroscopy. The measurements below 600 GHz (CD: $N = 1 \rightarrow 1$ and $^{13}$CH: $N = 1 \rightarrow 1$) were carried out at Arizona, while those in the 900 GHz range were conducted at JPL (CD: $N = 1 \rightarrow 1$). The two radical species were created in an electrical discharge of either $^{18}$CH$_4$ or CD$_4$. Both lambda-doubling and hyperfine splittings were resolved in the spectra. The data were analyzed with a case(b) effective Hamiltonian, resulting in an improvement in the lambda-doubling and deuterium, proton, and $^{13}$C hyperfine constants. Highly accurate rest frequencies are now available for astronomical searches for these species. CH is an abundant and widespread interstellar molecule, and thus CD and $^{13}$CH should be of astrophysical interest.