TUNNELING EFFECTS IN THE HYPERFINE STRUCTURE OF DEUTERATED ACETALDEHYDE

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Thanks to their high resolution, Fourier transform microwave spectrometers, coupled with a pulsed molecular beam, turn out to be a powerful tool for investigating the quadrupole hyperfine structure of molecules containing deuterium atoms. Indeed, the hyperfine structure arising from these atoms cannot be resolved using conventional microwave spectroscopy as the coupling constants, on the order of 20 kHz, are about 100 times smaller than those of molecules containing nitrogen atoms, which usually display an easily resolvable hyperfine pattern spread over several megahertz.

The present paper will be concerned with an experimental and a theoretical investigation of the hyperfine structure of deuterated acetaldehyde (CD_3CHO). In addition to providing us with values for the quadrupole coupling constants of the three nonequivalent deuterium atoms, this investigation will allow us to determine the effects of the large amplitude internal rotation on the hyperfine energy level pattern. Deuterated acetaldehyde displays a tunneling splitting of 209 MHz, *i.e.,* much larger than the deuterium hyperfine coupling. For this reason, an averaging of the quadrupole coupling of the three deuterium atoms is expected. This is confirmed by the measurements carried out for the A and E-type components of the $1_{01} \leftarrow 0_{00}$ transitions for which the hyperfine pattern could be fully resolved and analyzed. Measurements have been carried out for other tunneling rotational transitions. They display a more complicated hyperfine pattern which has not yet been analyzed.