THE GROUP TENSOR FORMALISM TO DESCRIBE THE HYPERFINE SPLITTING IN ND_3

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Currently there is a rapidly growing interest in the physics of cold molecules in general, and in the physics of cold polar gases in particular. In our laboratory, the Stark-deceleration technique has been developed, which exploits the interaction of dipolar molecules with strong time-varying electric fields to control the velocity of those molecules, allowing the creation of dense, cold samples of molecules [a]. Packages of molecules can be decelerated down to arbitrarily low velocities. This can be particularly beneficial in high resolution spectroscopic studies of gas-phase molecules, since the linewidths of the measured transitions are often determined by the interaction time of the molecules with the measurement apparatus.

Recently, pure inversion spectra of the para-species of deuterated ammonia in the ground state (J=K=1 state) have been measured using a molecular beam microwave-UV double resonance spectrometer. A resolution of 10 kHz was achieved, allowing the hyperfine structure to be fully resolved.[b] By implementing the Stark-decelerator in a future generation of this machine, we expect to be able to significantly improve the resolution in these MW spectra, down to the Hz level. In this presentation we report the symmetry group tensor formalism that we developed to describe the hyperfine splitting in the spectra of $XY_3(C_{3v})$ molecules. The formalism was tested and used in the simulation of the observed hyperfine splittings in the ND_3 J=1, K=1 state; the hyperfine manifold has 32 sublevels in the case of the $^{14}ND_3$ isotopomer and 22 sublevels in the case of the $^{15}ND_3$ isotopomer. The connection with the formalism commonly used to describe hyperfine splittings in NH_3 spectra [c] is derived.

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[a] H.L. Bethlem et al., *Nature* **406**, 491 (2000)

[b] J. van Veldhoven et al., *Phys. Rev. A* **66**, 032501 (2002)

[c] see i.e. S.G. Kukolich, *Phys. Rev.* **156**, 83 (1967) and referencies therein.