Population Transfer and Ultrahigh Resolution Spectroscopy in Ammonia : First Steps to Detect Parity Violation in Chiral Molecules

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According to our current understanding, the symmetry between the two enantiomers of chiral molecules is broken by the electroweak interaction and a slight energy difference $\Delta_{PV}E$ of the ground states of enantiomers is introduced, corresponding to a reaction enthalpy $\Delta_{PV}H_0^{\ominus}$ for the stereomutation reaction [1-4]

$$R = S, \qquad \Delta_{PV}H_0^{\ominus} = N_A \Delta_{PV}E \qquad (1)$$

Theoretical calculations of the parity violating energy difference in molecules are well established [2-5] but its experimental verification is still missing. We present an experimental scheme and the first experimental results for an approach where the time evolution of the population is probed for a superposition state which has been prepared with defined parity in a two-photon absorption-stimulated emission step [1]. In a first step we have investigated the population transfer in achiral NH_3 by two continuous wave IR-OPOs locked to a frequency comb with high frequency precision. Applying chirped laser fields a complete population transfer for each step could be confirmed experimentally in accordance with theoretical calculations taking into account the hyperfine structure of the transitions. In a high resolution experiment we have completely resolved the hyperfine structure of the v_1 transition in NH_3.

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