

## PARITY VIOLATION IN CHIRAL MOLECULES: CURRENT STATUS OF THEORY AND SPECTROSCOPIC EXPERIMENT

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In the ordinary quantum chemistry based on the electromagnetic interaction the ground state energies of enantiomers of chiral molecules are exactly the same by symmetry. Parity violation in electroweak interactions leads to a small “parity violating” energy difference  $\Delta_{pv}E$  between the ground states of enantiomers corresponding to a heat of reaction for stereomutation  $\Delta_{RH_0}^{\ominus} \simeq 10^{-11} \text{ J mol}^{-1}$ , (typically, or about 100 aeV corresponding to about  $10^{-12} \text{ cm}^{-1}$ ). After our finding (in 1995) that a revised theory leads to about a factor of 10 to 100 higher values than previously calculated in older theoretical work prior to 1995, the theoretical results from many groups have now essentially converged to the new values (see reviews <sup>a b c</sup>). However, experimental results for  $\Delta_{pv}E$  are still missing. We shall discuss the status of ongoing experiments in the Zürich group to detect this exceedingly small effect by spectroscopy following a scheme proposed in 1986 <sup>d e</sup> and shall discuss also the comparison with other efforts.

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<sup>a</sup>M. Quack, *Frontiers in Spectroscopy*, in *Faraday Discussions*, Vol. 150, pp. 533-565, **2011**.

<sup>b</sup>M. Quack, *Fundamental Symmetries and Symmetry Violations from High Resolution Spectroscopy*, in *Handbook of High Resolution Spectroscopy*, Vol. 1, Chapt. 18, pp. 659-722 (Eds.: M. Quack, F. Merkt), Wiley, Chichester, New York, **2011**, ISBN 978-0-470-06653-9.

<sup>c</sup>M. Quack, J. Stohner, M. Willeke, *High-resolution spectroscopic studies and theory of parity violation in chiral molecules*, *Annu. Rev. Phys. Chem.*, **2008**, 59, 741-769.

<sup>d</sup>M. Quack, *On the measurement of the parity violating energy difference between enantiomers*, *Chem. Phys. Lett.*, 1986, 132, 147-153.

<sup>e</sup>P. Dietiker, M. Quack, A. Schneider, G. Seyfang, F. Ünlü, *IR-laser induced population transfer from highly populated rotational levels of NH<sub>3</sub> in a molecular beam*, in *Proceedings of the 18th Symposium on Atomic, Cluster and Surface Physics 2012 (SASP 2012)*, Alpe d'Huez, France, 22 to 27 January 2012, pp. 263-267 (Eds.: M. Lewerenz, O. Dutuit, R. Marquardt), Innsbruck University Press (IUP), Innsbruck, 2012, ISBN 978-3-902811-42-4; and to be published.