CHIRAL CAVITY RING-DOWN: ABSOLUTE MEASUREMENT OF OPTICAL ROTATION IN GASES AND LIQUIDS WITH SIGNAL REVERSALS

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We demonstrate the absolute measurement of optical rotation using a four-mirror cavity-ring-down polarimetric setup. A four-mirror bow-tie cavity allows counter-propagating laser beams, for which symmetry is broken with a longitudinal magnetic field acting upon an intracavity magneto-optic window (producing a Faraday rotation θ_{F}). A chiral sample is introduced in one arm of the cavity, producing a chiral rotation φ_{C}. The different symmetry of the two rotations produces a total rotation of $(\theta_{\mathrm{F}} + \varphi_{\mathrm{C}})$ for one laser beam, and $(\theta_{\mathrm{F}} + \varphi_{\mathrm{C}})$ for the counter-propagating beam. These rotations produce a polarization beating in the cavity ring-down, of frequency ω_{CW} and ω_{CCW} for the clockwise and counter-clockwise beams, respectively. Analysis of the difference $(\omega_{\mathrm{CW}} - \omega_{\mathrm{CCW}})$ yields the chiral rotation angle $\pm\varphi_{\mathrm{C}}$, where the sign of the angle is determined by the sign of the applied magnetic field. Therefore, subtracting the signals using $+\vec{B}$ and $\vec{B}$ yields $2\varphi_{\mathrm{C}}$, allowing the absolute determination of φ_{C}, without needing to remove the sample [1]. We demonstrate these absolute optical rotation measurements for chiral gases (α-pinene) and chiral liquids.
This work is a proof-of-principle demonstration of the experimental setup proposed for the measurement of parity non-conserving optical rotation in atomic systems [1].

1 L. Bougas, G. E. Katsoprinakis, W. von Klitzing, J. Sapirstein, and T. P. Rakitzis, Phys. Rev. Lett **108**, 210801 (2012).