Breaking dynamic inversion symmetry in a racemic mixture using simple trains of laser pulses

Recent advances in ultrafast laser technology hint at the possibility of using shaped pulses to generate deracemization via selective enantiomeric conversion; however, experimental implementation remains a challenge and has not yet been achieved. Here, we describe an experiment that can be considered an accessible intermediate step on the road towards achieving laser induced deracemization in a laboratory. Our approach consists of driving a racemic mixture of 3D oriented 3,5-difluoro-3', 5'-dibromobiphenyl (F2H3C6–C6H3Br2) molecules with a simple train of Gaussian pulses with alternating polarization axes. We use arguments related to the geometry of the field/molecule interaction to illustrate why this will increase the amplitude of the torsional oscillations between the phenyl rings while simultaneously breaking the inversion symmetry of the dynamics between the left- and right-handed enantiomeric forms, two crucial requirements for achieving deracemization. We verify our approach using numerical simulations and show that it leads to significant and experimentally measurable differences in the internal enantiomeric structures when detected by Coulomb explosion imaging.

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Corresponding author: Henriksen, N. E.
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