Phase-Modulated Nonresonant Laser Pulses Can Selectively Convert Enantiomers in a Racemic Mixture

Deracemization occurs when a racemic molecular mixture is transformed into a mixture containing an excess of a single enantiomer. 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 suggest a simple, yet novel approach to laser-induced enantiomeric conversion based on dynamic Stark control. We demonstrate theoretically that current laser and optical technology can be used to generate a pair of phase-modulated, nonresonant, linearly polarized Gaussian laser pulses that can selectively deracemize a racemic mixture of 3D-oriented, 3,5-difluoro-3',5'-dibromobiphenyl (F2H3C6-C6H3Br2) molecules, the laser-induced dynamics of which are well studied experimentally. These results strongly suggest that designing a closed-loop coherent control scheme based on this methodology may lead to the first-ever achievement of enantiomeric conversion via coherent laser light in a laboratory setting.