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Optical control of coupled molecular states by ac Stark effect
JIANBING QI, Penn State University — Quantum states with different spin multiplicity can be coupled through the interaction of the spin orbital motion of electrons. For example, the spin-orbit coupled rovibrational levels in diatomic alkali, which have different multiplicity in terms of total spin quantum number, and are classified as singlet states (if the total spin is zero) and triplet states (if the total spin is one), respectively. A transition from the singlet level can only go to singlet levels and a triplet only to triplet levels. Due to the spin-orbit coupling, however, the coupled states mix each other, therefore both states have singlet as well as triplet character. By coherently coupling the pair to an auxiliary quantum state, varying the Rabi frequency of the coupling laser and the detuning of the laser frequency, the coupling of the two mixed singlet-triplet molecular rovibrational levels can be modified by ac Stark effect. We use density matrix equations and a five-level molecular model to show that a coupled singlet-triplet pair of rovibrational levels can be used as a channel to optically control quantum states.

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