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Probing Hole Spins in an InAs/GaAs Quantum Dot Molecule subject to Lateral Electric Fields XIANGYU MA, Univ of Delaware, GARNETT BRYANT, National Institute of Standards and Technology, MATTHEW DOTY, Univ of Delaware — Quantum dot molecules (QDMs) are structures in which coherent interactions between two or more adjacent quantum dots (QDs) can lead to unique, tunable electronic and spin properties. We explore computationally spin-mixing interactions in the molecular states of single holes confined in vertically-stacked InAs/GaAs self-assembled QDMs. We consider the spin properties of the hole states subject to electric fields that have components both parallel and perpendicular to the molecular stacking axis. We compute the energies of the QDM hole states under various electric and magnetic fields with a combination of full tight binding atomistic calculations and approximate atomistic results using eigenstates found at particular fields as a basis to extrapolate to other fields. We observe a relatively large Stark shift in hole states with the application of lateral electric fields, as well as a quenching of the Zeeman splitting. Most importantly, we observe that lateral electric fields induce hole spin mixing with a magnitude that increases with increasing lateral electric field over a moderate range. These results suggest that applied lateral electric fields provide an opportunity to fine-tune and manipulate, in situ, the energy levels and spin properties of single holes confined in QDMs.

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