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Two-Photon Transitions in Molecular Quantum Dot System MICHAEL SCHEIBNER, ILYA PONOMAREV, DANNY KIM, ALLAN BRACKER, DANIEL GAMMON, Naval Research Laboratory — Two-photon excitations are at the heart of important nonlinear optical processes and provide a key to the rich physics and fresh opportunities of designer quantum materials. In this study we consider double dot quantum dot molecules (QDMs) that were designed by molecular beam epitaxial growth to exhibit either electron or hole tunnel coupling of the two dots. The electron or hole levels of the two dots can be tuned into resonance with an applied electric field which is created by a Schottky diode structure surrounding the QDMs. Highly sensitive photoluminescence excitation spectroscopy is used to study sequential and simultaneous two-photon transitions in the absorption spectrum of the molecular biexciton in such a QDM. We identify a new two-photon transition which is the first example of a simultaneous, coherent optical excitation of a pair of QDs in a weakly tunnel coupled regime. We further show that a photoluminescence excitation measurement with stereo-chromatic detection can be used to gain access to the spin physics in this regime.

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