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Ground state initialization in a doubly-charged, vertically-stacked InAs quantum dot molecule AARON ROSS, COLIN CHOW, Department of Physics, University of Michigan, LU SHAM, University of California San Diego, ALLAN BRACKER, DANIEL GAMMON, Naval Research Laboratory, DUNCAN STEEL, Department of Physics, University of Michigan — We report on the rapid optical initialization of a subset of the two-electron ground states of a self-assembled, vertically stacked InAs quantum dot molecule, where the states of the electron are approximately localized to separate quantum dots with very little spatial overlap. Four eigenstates, a singlet and three triplets (S,T_0,T_+, T_-), arise from the exchange coupling and are identified via bias-dependent photoluminescence measurements. The degeneracy of the triplet states is lifted using an in-plane magnetic field (Voigt geometry). This allows for the determination of the in-plane electron and hole g-factors using differential transmission measurements in the co-tunneling regime (to avoid optical pumping). Three of the four eigenstates (S,T_+, T_-) can then be initialized with high fidelity using continuous wave (CW) optical pumping. Optical transition degeneracies prohibit simple CW initialization of the T_0 state. Efforts towards near-unity initialization of the T_0 state via two-photon Raman transitions will be presented. This work represents the first step in demonstrating a two-qubit quantum register based on electron spins in self-assembled quantum dots. This work is supported by NSF, ARO, AFSOR, DARPA, and ONR.

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