Abstract Submitted
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Intrinsic bi-directional dynamic nuclear polarization by optically pumped trions in quantum dots WEN YANG, L. J. SHAM, University of California, Department of Physics — We develop a microscopic theory for dynamic nuclear polarization (DNP) in a quantum dot through dipolar interaction between the nuclear spins and the hole spin in the optically generated trion in the Faraday configuration. In sharp contrast to other uni-directional DNP mechanisms where the resulting nuclear field always increases or decreases the electronic excitation energy, our theory shows that the DNP induced by the trion is bi-directional: for the laser frequency on the blue (red) side of the trion excitation, the nuclear field tends to increase (decrease) the trion excitation energy into resonance with the laser frequency.[1] As a result, the sharp Lorentzian trion absorption line is broadened nearly symmetrically into a round top with abrupt edges, where bistable states of the nuclear polarization manifest as hysteretic loops. This intrinsic bi-directional DNP mechanism serves as an alternative explanation to the recently observed bi-directional hysteretic enhancement of trion absorption in single InGaAs quantum dot [C. Latta et al., Nature Phys. 5, 758 (2009)], attributed to competition between two uni-directional DNP mechanisms. Our work is supported by NSF-PIF and ARO/IARPA. [1] Bi-directional DNP by the trion was first discovered and explained in a recent work in the Voigt configuration [X. D. Xu et al., Nature 459, 1105 (2009)].

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