Title:
A hybrid organic-nanocrystal excitonic state with triplet character

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Abstract:
In this poster, we show for the first time, an excited spin-triplet state with both organic and inorganic nanocrystal character. This photosensitized spin-active excited state may find utility in quantum information systems (QIS), or in singlet-fission enhanced photovoltaic devices. Previously, in this class of hybrid materials composed of nanocrystals functionalized with conjugated molecules, the exciton would reside either on the nanocrystal, or the molecule. Time-resolved spectroscopy would clearly show distinct contributions from the nanocrystal and molecular triplet state. Now, by enhancing the electronic coupling between anthracene and silicon nanocrystals using a conjugated π linker, a hybrid state with contributions from both anthracene and silicon is observed in nanosecond transient absorption spectroscopy. Using diphenylanthracene (DPA) and tetra-tertbutylperylene (BuP) as acceptors/ emitters for photon upconversion, we show that this hybrid state has a triplet energy level between 1.5 and 1.8 eV. Specifically, triplet photosensitizers comprised of silicon nanocrystals covalently functionalized with solubilizing dodecane linkers and conjugated 9-vinylanthracene molecules for photon upconversion resulted in quantum yields of 2% with DPA and 17% with (BuP). The strongly coupled spin-active state demonstrated here offers an avenue to control electronic and spin states degrees of freedom important for QIS.