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**Quantum Optics with Colloidal Nanocrystals in Solution** DAVID BUSSIAN, LANL, ANTON MALKO, Univeristy of Texas at Dallas, YONGFEN CHEN, JENNIFER HOLLINGSWORTH, HAN HTOON, VICTOR KLIMOV, LANL — Semiconductor nanocrystal quantum dots (NQDs) have been increasingly utilized in developing technologies such as lasers, light-emitting diodes, and bioimaging. Despite gaining popularity as labeling sources in bioimaging, no reliable method has been developed to characterize and identify single nanoparticles in solution, a requirement for efficient labeling at single-cell/single-NQD level. Here we present our recent results addressing the aggregation problem by combining FCS with photon pair correlation spectroscopy (PPCS). The combination of these two methods together with necessary theoretical treatment allows us to quantify, for the first time, the clustering degree of different nanocrystals in solution. The extent of aggregation in a sample can be straightforwardly determined by the deviation of occupation number between PPCS and FCS measurements. CdSe nanocrystals dispersed in organic solvents such as toluene or hexane have minimal clustering, usually less than 1.1 NQD/cluster and do not show considerable aggregation over time. To the contrary, commercially available water-soluble CdSe NQDs that are typically used for cell labeling show a tendency toward aggregation into small, 2-3 NQD clusters. In addition, the clustering degree of such dots increases over time rendering their use in single-dot labeling problematic.

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