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A comparative study of carrier multiplication in PbS and PbSe nanocrystals¹ JOHN STEWART, LAZARO PADILHA, DOH LEE, BISHNU KHANAL, JEFFREY PIETRYGA, VICTOR KLIMOV, Los Alamos National Laboratory — In this talk I will present our recent studies of carrier multiplication (CM) in PbS and PbSe nanocrystals (NCs). CM is a process in which absorption of a single photon produces multiple excitons. In our experiments, we evaluate its efficiency based on the amplitude of the Auger decay signature of multiexcitons in carrier dynamics recorded using both transient absorption and time-resolved photoluminescence. In the case of PbSe NCs, we have measured the CM quantum efficiencies and Auger lifetimes for a large range of NC sizes, including very large particles with a band gap around 0.5 eV. Using excitation at 3.1eV we observe that the quantum efficiency is low for small NCs and increases monotonically toward the bulk value for larger dots. Despite many apparent similarities in the band structure of PbSe and PbS NCs, our preliminary studies of PbS nanoparticles hint at a quite different spectral behavior of quantum efficiencies compared to PbSe NCs. In particular, while the quantum efficiencies are similar for smaller NCs, we see discrepancies for the larger NCs for which the energy gap approaches the bulk limit. We discuss these discrepancies in the context of our comparative studies of intraband relaxation and Auger recombination in these two types of the NCs.

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