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Non-radiative decay processes in InAs nanocrystals[1] MARCO CALIFANO, University of Leeds — The mechanisms governing excited state relaxation in semiconductor nanocrystals (NCs) are still not well understood. The validity of the Auger electron cooling and multiexciton recombination hypotheses, which would explain much of the experimental data available to date, has recently been questioned. Moreover the recent observation of sub-picosecond electron relaxation times and biexciton recombination rates of the order of 0.1-1 ps^{-1} in InAs, although qualitatively ascribed to Auger processes, still awaits a quantitative theoretical interpretation. Multiexciton recombination is particularly important as its signatures are used to detect and quantify carrier multiplication efficiency in NCs. Furthermore efficient non-radiative (multi-) exciton decay represents a major obstacle for application of NCs in lasing and photovoltaics. A quantitative theoretical understanding of these processes is therefore critical for any technological implementation of quantum-dot-based devices. The results of a detailed investigation using the pseudopotential method provide an explanation of the observed lifetimes in terms of Auger-like decay mechanisms, supporting the Auger interpretation of excited state relaxation in NCs.

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