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Peculiar many-body effects revealed in the spectroscopy of highly charged quantum dots M. EDIGER, Heriot Watt University, GABRIEL BESTER, National Renewable Energy Laboratory, A. BADOLATO, P. PETROFF, University of Santa Barbara, K. KARRAI, Ludwig-Maximilians-Universität, A. ZUNGER, National Renewable Energy Lab, R. WARBURTON, Heriot Watt University, NREL COLLABORATION, HERIOT WATT COLLABORATION, LMU COLLABORATION, UCSB COLLABORATION — We have discovered new consequences of Coulomb interactions in self-assembled quantum dots by interpreting experimental spectra with results of atomistic pseudopotential calculations. The Coulomb effects are evident in the photon emission process and we can tune them in situ by controlling the quantum dot charge in the range from $+6e$ to $-6e$. We find two regimes in the same dot: $J \leq \Delta E$ for electron charging yet $J \simeq \Delta E$ for hole charging. We discover a breakdown of the Aufbau principle for holes; clear proof of non-perturbative hole-hole interactions; promotion-demotion processes in the final state of the emission process; and pronounced configuration hybridizations in the initial state. The level of charge control and the energy scales result in Coulomb effects with no obvious analogues in atomic physics.

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