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Differential Gain of Closely Spaced Energy States in Quantum Dashes

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Abstract: Simple quasi-equilibrium model for quantum dash (QDash) active material is derived for closely spaced energy states. The model is used to study the differential gain of Qdash for different key parameters. Expressions for the electron and the hole occupation probabilities as a function of electron concentration are derived. The derived analytical model shows excellent agreement with numerical simulation. The differential gain of Qdash active layer is calculated for different doping concentration and different electron energy separation between adjacent states. We find that when the electron energy states are widely separated, the differential gain can be slightly enhanced at low-energy detuning by doping the dashes by p-type doing. On the other hand, our calculations reveal that when the electron energy states are close to each other, doping the dashes by either n-type or p-type concentration will not enhance the differential gain.