From Equilibrium- to Non-Equilibrium Interaction in Coupled Quantum Dot Devices

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Abstract :

Solid state based quantum dots (QDs) are heavily discussed for applications as qubits, but also provide a beautiful playground for basic research on artificial molecules. At first, concepts needed to understand transport and charge spectroscopy measurements on coupled QD devices will be developed.

Our unique few electron serial triple QD is electrostatically defined in a standard GaAs/AlGaAs heterostructure containing a two-dimensional electron system. Ground state stability diagrams detected with a single quantum point contact demonstrate complete control of the charge configuration of the triple QD in the few electron regime. The complex interplay between charge states of the three coupled QDs near points of high degeneracy will be discussed. In this regime electron transport through the three QDs reflecting quantum cellular automata physics is observed. This goes well beyond the processes observable in double QDs.

The second part of the talk will be devoted to the backaction of a driven quantum point contact, used as charge detector, onto potential qubits, namely coupled QD-devices. In this case the charge detector acts as non-equilibrium energy source and, as such, it would inevitably limit the coherence time of a qubit. To illuminate the backaction mechanism the interaction between two electrically isolated quantum point contacts is investigated. It suggest a prominent role of phonons mediating non-equilibrium energy between solid state based nano devices.