Kondo Effect in Few-Electron Quantum Dots

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The Kondo effect is a many particle entangled system, that involves the interaction between a localized spin in the quantum dot and free electrons in the electron reservoirs. Its ability to manipulate the spin and the conductance of the quantum dot makes it of an important consideration in the design and implementation of spin-based qubits in quantum dots.

In this work, the investigated quantum dot device is formed electrostatically in a two-dimensional electron gas using top-gates. A quantum point contact in the vicinity is used as a sensitive charge detector allowing the detection of single-electrons tunneling through the system [1,2]. This enables us to know the exact number of electrons in the quantum dot (N_e). The latter is varied by changing the applied gate voltage.

Here we present a detailed investigations of Kondo effect in the third shell [3] of a quantum dot. For $N_e = 6$ and $N_e = 12$, no Kondo effect is observed. However, for 7 to 11 electrons occupying the quantum dot a Zero-bias anomaly (ZBA) [4,8] is observed. This Kondo resonance is strongest for $N_e=9$ and displays a particle-hole symmetry for $N_e = 7$-11, indicating the influence of the filling of the shell structure of the electronic states in the quantum dot where orbital degeneracy is present.

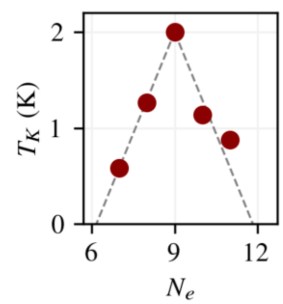

Fig.1. The Kondo temperature T_K for the different occupation numbers N_e.

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