Entropy Measurement in a Mesoscopic Double Quantum Dot

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Entropy is one of the most fundamental physical quantity in physics, yet its direct measurement is inaccessible in many cases. Despite its obscure nature, entropy plays a crucial role in understanding the vast range of physics, from classical heat engines to quantum information theory. Its statistical definition, indicating a given system's available degree of freedom, has attracted attention as a suitable parameter for exploring exotic quantum states in theory. However, measuring entropy in minuscule-scale quantum devices has remained an experimental challenge. Recently, the measurement of a single electron's entropy in a quantum dot has been demonstrated based on the Maxwell relation, showcasing a promising method for probing exotic quantum states. In this study, we have advanced the application of the technique to a double quantum dot system, where the entropy measurement with a tunnel coupling has never been done before. By varying the tunnel coupling between the dots from capacitive to tunnel coupling regime, we have observed potential entropy change due to the change in the electron configurations within the dots. This investigation highlighted entropy measurement as a valuable technique for understanding quantum states.