Kondo Correlations and Competing Orders in a Quadruple Quantum Dot Hybrid System

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Owing to their great tunability, quantum dot-based systems enable the study of exotic forms of magnetism [1] and their interaction with various physical phenomena such as superconductivity [2] and Kondo correlations [3]. In hybrid systems, synergy and competition between different types of correlations give rise to rich physical behavior with applications in quantum computing [4,5].

In this contribution, we investigate the competition between superconducting, ferromagnetic, and Kondo correlations in a quadruple quantum dot arranged in a square lattice, placed on the surface of an s-wave superconductor and probed by strongly coupled ferromagnetic tips. The quadruple quantum dot system is known to exhibit Nagaoka ferromagnetism [1] within a specific range of parameters. On the other hand, proximity to a superconductor and strong coupling to ferromagnetic electrodes induce superconducting and Kondo correlations, respectively.

We calculate the Andreev current, differential conductance, and non-local current correlations using the numerical renormalization group, in the limit of an infinite superconducting energy gap. Our results contribute to the understanding of strongly correlated systems and hybrid superconducting nanostructures, providing new insights into the interplay between Andreev reflections and various forms of electron correlations in quantum dot hybrid systems.

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