Contribution ID: **38** Type: **not specified**

Cooper quartets in interacting hybrid superconducting systems

Wednesday, 11 September 2024 15:35 (15 minutes)

Cooper quartets represent correlated matter at the basis of charge-4e superconductivity and offer a platform for studying four-body interactions, of interest for topologically protected quantum computing and strongly correlated matter. Focusing on solid-state systems, we show how to quantum design Cooper quartets in a double-dot system coupled to ordinary superconducting leads through the introduction of an attractive interdot interaction. A fundamentally novel, maximally correlated double-dot ground state, in the form of a superposition of vacuum $|0\rangle$ and four-electron state $|4e\rangle$, emerges as a narrow resonance in a many-body quartet correlator that leads to non-local coherence and novel phenomenology in the dissipationless transport. The systems represents an instance of correlated Andreev matter and the results opens the way to the exploration of interaction effects in hybrid superconducting devices, and the study of novel correlated states of matter with ingredients available in a quantum solid-state lab.

Title

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