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Title:

Control and Readout of Single Electrons on Liquid Helium

Abstract:

Recent experimental advancements have revealed the promising potential of emerging quantum information processing (QIP) systems based on electrons confined above cryogenic noble gas substrates, such as solid neon and liquid helium. However, reliably controlling both the classical and quantum degrees of freedom for surface-state electrons on liquid helium remains a significant engineering challenge. In this context, we present progress in detecting small numbers of electrons using superconducting microwave resonators. We address the challenges involved in measuring electrons using circuit-QED techniques, providing experimental evidence of single-electron detection at different temperature regimes. Additionally, we introduce a theoretical framework for the coupling of single and many electrons to microwave resonators, offering insights into the observed phenomena.