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Theory of switchable half-quantum flux rings of the kagome superconductor CVS

Ilaria Maccari,[1] Mark Fischer,[2] and Manfred Sigrist[1]

[1] *ETH Zürich*
[2] *University of Zürich*

The fundamental nature of the superconducting state in CsV_3Sb_5 remains highly debated. Recent Little-Parks measurements on CsV_3Sb_5 single-crystal rings highlight robust anomalous behavior, revealing half-quantum flux oscillations in nearly all tested samples. Strikingly, a finite bias current can reversibly tune these rings back to a standard zero-flux state. These observations are incompatible with a conventional superconducting framework. We examine the mechanisms underlying these half-quantum-flux oscillations and their current-driven switching. Our findings suggest the presence of a multi-component order parameter. Specifically, we propose that two competing superconducting states couple differently to the applied bias current, fundamentally altering their energetic balance. In this model, the applied current acts as a tuning parameter that controls the dominant instability, successfully explaining the crossover from half-quantum to zero-flux behavior.

[1] https://arxiv.org/abs/2512.10010.