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Localization of Metal-Induced Gap States at the Metal-Insulator Interface: Origin of Flux Noise in SQUIDs and Superconducting Qubits SANGKOOK CHOI, DUNG-HAI LEE, STEVEN G. LOUIE, JOHN CLARKE, University of California at Berkeley and Lawrence Berkeley National Lab — The origin of magnetic flux noise in dc Superconducting Quantum Interference Devices (SQUIDs) with a power spectrum scaling as 1/f (f is frequency) has been a puzzle for over 25 years. This noise limits both the low frequency performance of SQUIDs and the decoherence time of flux-sensitive superconducting qubits, making scaling-up for quantum computing problematic. Recent calculations and experiments indicate that the noise is generated by electrons that randomly reverse their spin directions. Their areal density of $\sim 5 \times 10^{17}$ m⁻² is relatively insensitive to the nature of the superconductor and substrate. Here, we propose that the local magnetic moments originate in metal-induced gap states (MIGSs) localized by potential disorder at the metal-insulator interface. MIGSs are particularly sensitive to such disorder, so that the localized states have a Coulomb repulsion sufficiently large to make them singly occupied. Our calculations demonstrate that a modest level of disorder generates the required areal density of localized moments. This result suggests that magnetic flux noise could be reduced by fabricating superconductor-insulator interfaces with less disorder. Support: NSF DMR07-05941, US DOE De-AC02-05CH11231, Samsung Foundation, Teragrid, NERSC.

> Sangkook Choi University of California at Berkeley and Lawrence Berkeley National Lab

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