Low Frequency Flux Noise in dc-SQUIDs: Dependence on Temperature and SQUID Geometry

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It is widely accepted that low frequency flux noise in SQUIDs and qubits is due to local fluctuators (e.g. metal-induced gap states [MIGS] at metal-insulator interfaces). We have measured the flux noise in six conventionally fabricated SQUIDs with washer widths ranging from 5 to 160 microns, four identical conventionally fabricated SQUIDs, and six identical epitaxially grown SQUIDs. We find that the flux noise in the epitaxially grown SQUIDs, which are thought to have fewer noise-producing MIGS due to the ordered metal/insluator interface, is lower than that of the conventional SQUIDs at the lowest temperatures. All SQUIDs exhibit a minimum in flux noise at 1 Hz near 1.5 K, with a significant increase in flux noise as the temperature is further decreased. The frequency dependence of the flux noise power spectrum is not strictly 1/f; instead, the slope ranges from 0.6 to 1.2 as the temperature is varied, with a minimum again near 1 K. Remarkably, the slopes of the power spectra converge to 0.8 at the lowest temperatures in all of the conventional SQUIDs. We expect these observations to provide clues regarding the nature of the correlations between the fluctuators that give rise to the flux noise.