Geometry and temperature dependence of low-frequency flux noise in dc SQUIDs S.M. ANTON, J.S. BIRENBAUM, S.R. O’KELLEY, UC Berkeley, D.S. GOLUBEV, G.C. HILTON, H.-M. CHO, K.D. IRWIN, NIST, Boulder, V. BOLKHOVSKY, D.A. BRAJE, G. FITCH, M. NEELEY, R.C. JOHN-SON, W.D. OLIVER, MIT Lincoln Laboratory, F.C. WELLSTOOD, Univ of Maryland, JOHN CLARKE, UC Berkeley — Measurements on dc SQUIDs reveal a flux noise spectral density $S_\Phi(f) = A^2/(f/1 \text{ Hz})^\alpha$. An analytic model assuming non-interacting spins localized at the surface of the SQUID loop predicts that the mean square noise scales as $R/W$—the radius and width of the loop, respectively. However, there are no established theories for the scaling of $\alpha$ with geometry or the dependences of $A$ and $\alpha$ on temperature $T$. To test the predicted geometric scaling of this model experimentally, we measured flux noise in ten SQUIDs with systematically varying geometries. We find that, at fixed $T$, $A^2$ scales approximately as $R$. From the measured values of $A$ and $\alpha$, we estimate the mean square flux noise, which does not scale with $R$. As $T$ is lowered, $\alpha$ increases significantly and in such a way that the spectra “pivot” about an approximately fixed frequency. This phenomenon implies that the mean square noise is temperature-dependent, an effect not predicted by the analytic model. We discuss our attempts to reconcile these discrepancies by considering the locking together of spins to form clusters.

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