Spinlike Susceptibility of Metallic and Insulating Thin Films at Low Temperature

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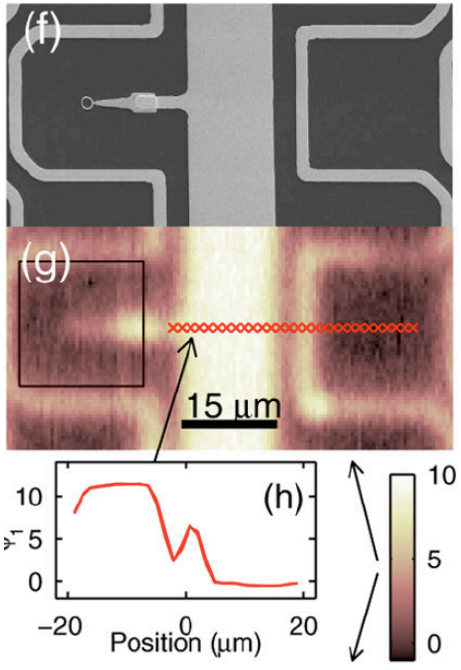
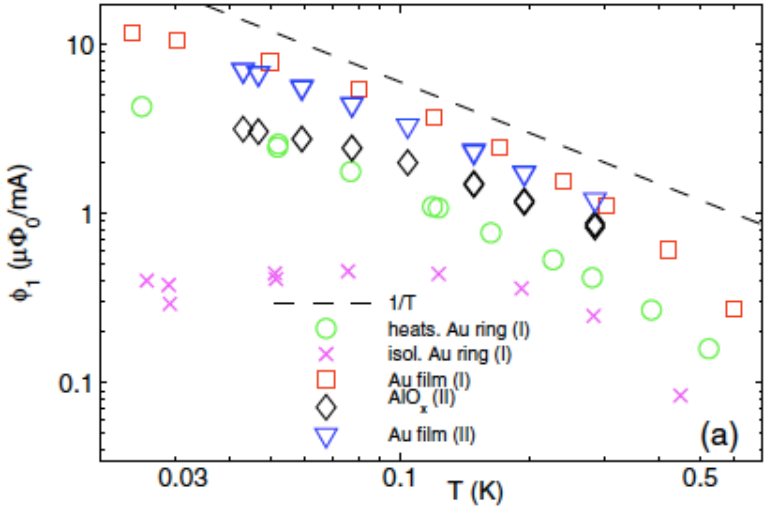
The origin of 1/f noise in superconducting quantum interference devices (SQUIDs) has been an unresolved mystery for more than two decades. Susceptibility measurements of patterned thin films at sub-K temperatures were carried out using a scanning SQUID microscope that can resolve signals corresponding to a few hundred Bohr magnetons. Several metallic and insulating thin films, even oxide-free Au films, show a paramagnetic response with a temperature dependence that indicates unpaired spins as the origin. The observed response exhibits a measurable out-of-phase component, which implies that these spins will create 1/f-like magnetic noise. The measured spin density is consistent with recent explanations of low frequency flux noise in SQUIDs and superconducting qubits in terms of spin fluctuations, and suggests that such unexpected spins may be even more ubiquitous than already indicated by earlier measurements.



(f) Optical image of fabricated microstructures
(g) Magnetic susceptibility image showing the presence of tiny amounts to unexpected magnetism in gold microstructures



Temperature dependence of the in-phase linear susceptibilities (Φ_1)

REFERENCE:
"Spinlike Susceptibility of Metallic and Insulating Thin Films at Low Temperature"
H. Bluhm, J. Bert, N. Koshnick, M. Huber, K. Moler, *Physical Review Letters,* **103,** 026805 (2009)