On the detection of local (quantum phase?) fluctuations in disordered superconductors

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Recent advances in the detection of quantum phase fluctuations have stimulated the search for spatiotemporal correlations in thin superconducting films. A non-zero entanglement entropy in such a system would greatly challenge current theoretical models on the superconductor to insulator transition and pave the way for a deeper understanding of the quantum nature of highly correlated electron systems. This work shows that nanometre sized SQUIDs are suitable for AC susceptibility measurements of superconducting films and further demonstrates that telegraph noise patterns as found in Ref. [1, 2] can be reproduced. Next steps include measuring the diamagnetic response at multiple positions at the same time and integrating our device under a home-build SQUID-on-tip microscope.

Figures

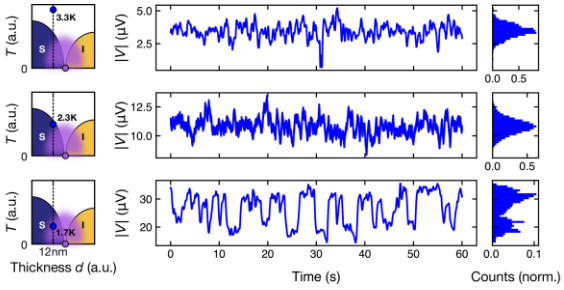

Figure 1: Local AC voltage response of a nanoSQUID covered by a disordered 12nm MoGe film. Applying an AC current through a near by superconducting stripline induces a characteristic magnetic susceptibility response in the thin film. Far below the transition temperature, we observe switching events between states of enhanced and decreased diamagnetic response.

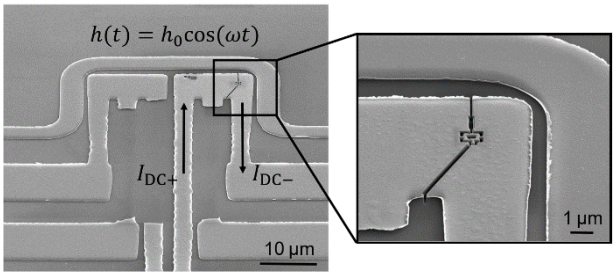

Figure 2: The device under test. Applying a current through a superconducting stripline generates a local magnetic field. The AC voltage across the SQUID is a measure for the magnetic response of any film deposited above.

References

[1] Shai Wissberg, Aviad Frydman, and Beena Kalisky. Local view of superconducting fluctuations. Applied Physics Letters, 112(26), 2018.

[2] A Kremen, H Khan, YL Loh, TI Baturina, N Trivedi, A Frydman, and B Kalisky. Imaging quantum fluctuations near criticality. Nature physics, 14(12):1205–1210, 2018.