SQUIDs De-fluxing Using a Decaying AC Magnetic Field

Andrei N. Matlashov[1], Vasili K. Semenov[2], William H. Anderson[3]

[1]Physics Department, Los Alamos National Laboratory, Los Alamos, NM 87545, USA
[2]Department of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794-3800
[3]Senior Scientific, LLC, Albuquerque, NM 87106, USA

E-mail: matlachov@lanl.gov

Abstract — Flux trapping is the Achilles' heel of all superconductor electronics. The most direct way to avoid flux trapping is a prevention of superconductor circuits from exposure to magnetic fields. Unfortunately this is not feasible if the circuits must be exposed to a strong DC magnetic field even for a short period of time. For example, such unavoidable exposures take place in superparamagnetic relaxation measurements (SPMR) and ultra-low field magnetic resonance imaging (ULF MRI) using unshielded thin-film SQUID-based gradiometers. Unshielded SQUIDs stop working after being exposed to DC magnetic fields of only a few Gauss in strength. In this paper we present experimental results with de-fluxing of planar thin-film LTS SQUID-based gradiometers using a strong decaying AC magnetic field. We used four commercial G136 gradiometers for SPMR measurements with up to a 10 mT magnetizing field. Strong 12.9 kHz decaying magnetic field pulses reliably return SQUIDs to normal operation 50 ms after zeroing the DC magnetizing field. This new AC de-fluxing method was also successfully tested with seven other different types of LTS SQUID sensors and has been shown to dissipate extremely low energy.

Keywords (Index Terms) — SQUID, gradiometer, flux trapping, demagnetization, de-fluxing, alternating current de-fluxing, decaying magnetic field.