Prototype Module of a Robust 18-channel Magnetometer System

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Abstract — We present the prototype module of our robust multichannel SQUID magnetometer system which is intended for high-precision in biomagnetic measurements and nuclear spin precession experiments. Further demanding applications are magnetorelaxometry and ultra-low field NMR, where pulsed magnetic fields of up to 50 mT are typically applied. The system is operated in a flat bottom liquid helium dewar placed inside the Berlin Magnetically Shielded Room (BMSR-2). It contains 18 magnetometers and will be the basis for a modular multichannel system. The magnetometers are designed with Nb wire-wound flux antennas. A total of 16 small antennas (17.1 mm diameter) form a regular grid with individual channels sensitive to all three spatial directions. Two large antennas with 74.5 mm diameter sensitive in z-direction surround the grid at two different heights and allow the detection of deep sources. Each antenna is connected to the input of a thin-film Nb SQUID current sensor via a detachable contact. The SQUIDs are equipped with integrated input current limiters. Feedback into the antennas is employed to minimize crosstalk. The current sensor chip package involves a superconducting shield of Nb. The configuration of the SQUID magnetometers and the multichannel arrangement does not significantly degrade the superior magnetic environment inside the BMSR-2 which has been verified by simulations. The measured white filed noise of the small-size magnetometers was between 0.52 and 1.3 fT/√Hz, and well below 1 fT/√Hz for the large ones. The experimental performance of the prototype module will be discussed in detail.

Keywords (Index Terms) — SQUID, multichannel SQUID system, ultra-low-field NMR, MEG.