Measuring Small Magnetic Fields in Living Systems: From Understanding the Brain to the Detection of Cancer

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Many biological processes, such as the activity of neurons in the brain, inherently produce tiny but detectable magnetic fields. It is also possible to "label" certain kinds of biological processes magnetically. Measuring these magnetic fields can then provide information about the location and/or timing of the process under study. In the biophysics group at Los Alamos National Laboratory we use small passive detectors called SQUIDs, superconducting quantum interference devices, to detect these magnetic fields. The SQUID is the most sensitive detector of magnetic fields known, capable of measuring magnetic fields one million times smaller than that of the earth.

This talk will focus on the activities of the Biophysics group at Los Alamos National Laboratory, in particular the novel application of SQUIDs to detecting tiny magnetic fields of biological origin. We will present information on the design and the data collected from a novel 150 SQUID system built to measure the magnetic fields present outside of the brain produced by neuronal activity. This technique, known as magnetoencephalography, or MEG, helps to shed light on the location and timing of brain function. We will also present a novel technique for cancer detection, and possibly treatment, that involves labeling cancer cells with small magnetic beads. The cancer can be detected by its magnetic signature and possibly treated by localized heating of the magnetic beads. Other neat stuff we do with SQUIDs will also be discussed.