Low-background Counting Facilities

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The LBNL Low Background Facilities (LBF) consist of a Berkeley site and an Oroville site specially configured for low-background gamma-ray spectroscopy. The Berkeley site was established in 1963 and consists of a 3m by 7m x 3m room surrounded by 1.6m of specially selected low-background concrete shielding. The aggregate in this concrete is from serpentine gravel, which is low in U, Th, and K, and emits very little radon.

Detectors at this site include a 20 cm diameter by 10 cm thick NaI crystal, two 30% p-type Ge spectrometers, two 80% p-type Ge spectrometers, available for fieldwork, and a 115% n-type spectrometer suitable for observing Pb-210 decay. These detectors each have small local shields consisting of 10 cm of Pb. The overall shielding reduces background to the point where cosmic rays and activity within the detector assembly are the dominant sources of background.

The LBF Oroville site is located in the powerhouse of the Oroville Dam, under 180-m of rock cover. This site now has an 80% p-type Ge-spectrometer, and is used for our most sensitive counting, particularly for materials certification. Sensitivities of 50 parts-per-trillion (PPT) for U and daughters, 200 PPT for Th and daughters, and 100 parts-per-billion for K are realized at the Oroville site.

Over the years, the LBF has been involved in a wide variety of experiments supporting programs in basic and applied science from LBNL and a variety of other institutions. This last year, work mainly involved: 1) low-activity materials certification for CDMS and KamLAND, 2) various activities related to CUORE (Cryogenic Underground Observatory for Rare Events), 3) Bevalac Decommissioning, and 4) use of automotive air cleaners as collectors for radioactive aerosols following a potential nuclear terrorist act. 5) studies of radioactivity in and around CCDs used in astronomy applications, and 6) site characterization of natural and fallout radionuclides in surficial soils.

Certification of materials work continued for CDMS and KamLAND, mostly involving direct counting. Some of the CDMS work involved neutron activation of materials at the McClellan Nuclear Research Center in California.

Neutron activation work continued with the fabrication of NDT Ge thermistors for the CUORE experiment in Italy. Irradiations were performed at both the MIT and Missouri reactors. Protocols are being developed to produce the one- to two-thousand nearly identical thermistors needed for CUORE.

A large amount of work went into the actual construction of the improved MiBeta and Cuoricino (little CUORE) experiments in Italy, including crystal polishing, thermistor attachment, and tower construction.

Work has begun on Bevalac decommissioning. Current studies involve counting both concrete and steel components in order to determine the magnitude of the disposal project. Samples of nuts and washers around the ring were counted to map out the radioactivity in the steel. 110 large concrete blocks were counted and certified clean for free release. Current efforts involve counting magnets and steel for disposal.

A new project related to Homeland Security was started to study radioactivity trapped in automotive air filters. The sensitivity to Co-60 is better than 100 pico-Curies total activity on the filter, as determined from the natural Be-7 activity. This technique could be used to monitor the spread of radioactivity following a terrorist attack. Air filters from Berkeley and Oroville are being studied.

Large CCD arrays for astronomy show spurious events not related to observation or cosmic rays. Studies at the Oroville site confirm that these events are from radioactivity in materials near the CCDs, including activity in the concrete of the telescope. We are in the process of studying these CCDs with neutron activation.