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Determination of Fixed Radioactivity in LZ detector components

Content

LUX-ZEPLIN (LZ) is a near-future dark matter experiment that is on track to make an unprecedented spin independent cross section limit of 3 x 10-48 cm2 at 40 GeV/c2 for the Weakly Interacting Massive Particle (WIMP). To reach this target sensitivity, LZ requires careful control of intrinsic long lived radioactive isotopes (including 238U, 232Th, 40K, 60Co) in all structural materials and assembled detector components. In preparation for the construction phase, an extensive campaign of low background screening has been carried out for the purpose of choosing sufficiently radiopure materials. The majority of the work was completed using a suite of ultra-low background high-purity germanium detectors maintained by LZ collaborators, and located at two underground sites (Sanford Underground Research Facility in South Dakota and Boulby Underground Laboratory in the United Kingdom) and two surface locations (Lawrence Berkeley National Laboratory and The University of Alabama). Several detector types (p-type, n-type, BEGe, and well) ensure sensitivity to gamma rays within a wide range of energies (3 - 3000 keV) and allow measurements of concentrations required for LZ materials (˜10 ppt). Due to high cross sections for (alpha,n) reactions and close proximity to the central active volume of xenon, the PTFE required neutron activation analysis to reach more stringent sensitivities of ˜1 ppt. Other methods that are being used in place of or in addition to gamma ray spectroscopy include: inductively coupled plasma mass spectroscopy, alpha spectroscopy, and radon emanation studies. We will present results for the most important elements of the detector (Ti cryostat, PMT bases, PMT raw materials, PTFE, and other components) and demonstrate that all measurements are well below concentration limits required for LZ to meet its background target. We will discuss the current status of LZ material screening: all materials for building LZ have been identified and continued screening will focus on quality control measurements and determination of as-built levels of contamination in completed components.

About the Presenter

The work described in this abstract is part of a coordinated submission by the LZ collaboration. The presenter, Kelsey Oliver-Mallory, is a graduate student working on low background material screening for the LUX and LZ experiments at University of California Berkeley and Lawrence Berkeley National Laboratory. Her personal contributions to this effort include being part of the team setting up and maintaining the germanium detectors at Sanford Underground Research Facility, as well as creation of software for the autonomous liquid nitrogen control system used for detector cooling.

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