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The Low Background Laboratory at Idaho State University

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The Deep Underground Neutrino Experiment (DUNE) hopes to study in great detail atmospheric, solar and supernova neutrino events. In order to do so, the background radiation at both the near detector (at Fermilab) and the far detector (at the Sanford research facility in South Dakota) must be understood in great detail. The Low Background Laboratory (LBL) is to be built at Idaho State University (ISU) to understand this background radiation and will be used to control the radio-purity of materials used in the construction of both of the DUNE detectors. The goal of the proposed LBL is to provide a tool to identify the most practical and radiologically clean materials to be used by DUNE and to model the background radiation to be expected in the DUNE detectors over the next 20 years. The cosmic ray background at 4850 feet depth will be relatively small. The background from naturally occurring radioactive isotopes however, is expected to be substantial. Just one of the radioactive isotopes in the detector, i.e. 39Ar, is expected to produce a 20KHz background signal, which will severely degrade the detector performance at low energy. Other natural radioactive isotopes, e.g. 40K, 220Rn and 222Rn and the other isotopes from the Uranium and Thorium decay chains, are expected to produce comparable, or higher backgrounds. The LBL will allow us to substantially reduce those radiological backgrounds which we can control by allowing us to select construction materials not only for their performance, but also for their radiological purity. In order to measure as accurately as possible the radiological purity of construction materials, the LBL will reduce the Radon related background by an expected 90% by placing the entire detector system in a class 10000 clean room with autonomous HVAC system, HEPA filters, and the ability to maintain overpressure. The combination of passive and active shielding will substantially reduce the background. We will estimate the background reduction factor with Monte Carlo simulations and in situ measurements. Finally, the LBL will model the background radiation to be expected at both the near and far detectors using GEANT4 on the College of Science and Engineering's Minerve cluster.

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