Contribution ID: **11** Type: **not specified**

Reduction of Cosmogenic Radioactivity in Low Background Detectors

The elimination of radio isotopes generated by high-energy cosmic-ray neutrons from detector materials is critically important to achieve the maximum sensitivity in, for example, dark matter, double-beta decay, and axion searches. A clear demonstration of such a reduction was observed in the low-energy spectrum from the MAJORANA DEMONSTRATOR (MJD). In particular, the beta spectrum from cosmogenic tritium, usually observed in germanium detectors, was reduced by a factor of 20 in the MJD spectrum. This was achieved by zone refining the input Ge, and by re-zone refining scrap Ge at each step, and by storing all material underground whenever it was not being used in production. The facility used by MJD, and its operation, were very costly and required significant space and infrastructure. A novel method is under development, which if successful, could purify Ge, TeO2, and possibly LiMoO4, all materials that are being used in low background experiments. The entire facility is compact, and could be operated underground. A description of the facility and techniques, as well as a progress report, will be given.

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