Radiation Usage in Lyman 31

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The ACME collaboration, led by Professors John Doyle and Gerald Gabrielse at Harvard and Professor David DeMille at Yale, requests that the right-hand fume hood in Lyman 31 be certified for work with the radioisotope thorium-232, an alpha-emitter with a half-life of 1.4×10^{10} years. Its properties and health hazards, as well as the protocol for handling it are discussed in the document "Standard procedures for radioactive material use in the ThO EDM experiment." The lab space in Lyman 31 is supervised by Professor Doyle, and the radiation permit holder is Professor Gabrielse (permit No. BGG). Included below is a description of the work to be done under this certification.

The source of molecules in the ACME experiment is a ceramic pellet of thorium dioxide that is laser ablated in a sealed vacuum chamber. We fabricate the ceramics and store all thorium in a radiation-certified lab in the Laboratory for Particle Physics and Cosmology, and we bring the ceramics to the fume hood in Lyman 31 only to complete the final ablation target preparations. In the fume hood, we break small pieces weighing about 0.2 grams (0.02 microcuries) off a larger pellet weighing about 10 grams (1 microcurie). We then glue the small pieces to a holder that is placed in the vacuum chamber for ablation. Safety precautions taken during this procedure include handling the material with two pairs of rubber gloves, covering the target preparation area of the fume hood with a disposable mat that is thrown away afterwards as radioactive waste, wipe-testing all tools and surfaces used in target preparation with an alpha particle scintillation detector, wearing a dust mask whenever thorium is exposed to air, and transporting thorium from one lab to another in at least two layers of radioactively clean ziplock bags.

In the future, we may also wish to experiment with other physical and chemical forms of thorium, including solid thorium metal, thorium foil, thoriated tungsten, and pressed and loose mixtures of thorium metal and thorium dioxide powder. The preparations performed in the fume hood, however, will be very similar to those described above and will largely consist of assembling materials and affixing them to mounts for use in the experimental apparatus.

The amount of thorium-232 handled in the fume hood in Lyman 31 is very small, and the tasks performed are relatively quick and simple; therefore, this work presents minimal environmental and safety risks. Moreover, it is essential to our experiment to have a radiation-certified location in Lyman Laboratory where we can perform final preparations on the thorium samples.