Final Report

Development of Quartz Structures for Ultralow Background High Pressure Phototubes

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Summary

The aim of this proposed work was to develop spherical fused silica structures with robust electrical feed-throughs that could house the photocathode and electron multipliers for photo detection and be able to operate at high pressures (10-20 bar). The main idea behind this work was that with high radio-pure ingredients like fused silica and non-indium metal seals, that one could fabricate the ultimate in radio-quiet photo detectors to be used in these rare event searches. We proposed a year long program to develop quartz sphere structures and demonstrate their pressure tolerance, to study the internal electrostatics (without detector chips/photo detectors), and begin investigation of methods to detect the photoelectrons including electron bombarded scintillators and electron bombarded silicon. After completion of this work, the plan was to seek industrial partnership to develop a suitable photocathode and produce a commercial product.

With optimization for room temperature operation and high pressures, it was felt this line of research was complementary to the development of quartz-based detectors (QUPID) that were proposed primarily for cryogenic operation.

However, due to competing research commitments in 2010-11 to the LUX and NEXT experiments that overlapped in time with this proposed work, and due to the withdrawal from our graduate program of the student who was to work on this project, this project never moved into the fabrication phase. Dr. White's did have several discussions with our local glass shop expert regarding the fabrication of such a device. In addition, he had another student investigate metal-to-glass seals, mechanical strengths of spherical vessels and also carry out a few COMSOL calculations to show the focusing ability of the final product. However, without a dedicated student to carry the project forward, Dr. White's team had no alternative but to leave this project for a later time, which never materialized, and as a result none of these funds were ever expended.

The development of these structures is still of considerable interest in the dark matter and double beta decay community, so it is unfortunate that this work was not completed before Dr. White's untimely death (7/13).