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Columbia Univeristy R&D program for large mass DarkMatter detector with LXe TPC

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The next generation of Dark Matter detectors based on dual-phase (liquid/gas) Xenon Time Projection Chambers (TPCs) will require an active volume of liquid with a mass on the tonne-scale in order to reach the desired sensitivity to WIMP-nucleon interactions. One natural and effective way to increase the target mass is to build a TPC with larger cross-sectional area and longer drift distance. Construction and operation of such a detector leads to many new issues and technological challenges which need to be addressed. One example is that electronegative impurities in the liquid must be at or below the ppb level, to prevent loss of the charge signal. This challenge can be overcome with an efficient filtering system for the evaporated liquid, capable of a circulation rate on the order of 100 SLPM. This high flow rate, however, requires an increased heat input to take advantage of the high cross-section for purification of the hot Xenon gas. Another well-known, major challenge to a tonne-scale detector is the requirement of very high voltage (˜ 50-100 kV) to generate a suitable drift field inside the TPC. Work is under way at Columbia University to study these and other issues associated with the construction of XENON1T with the so-called DEMONSTRATOR R&D program. In this talk, we will highlight the major results of this effort.

Summary

An extensive R&D program is on ongoing at the Columbia University to address the main technical issues of a possible multi-ton DarkMatter LXe TPC. In this talk we review in detail the studies done so far.

Primary author: Dr MESSINA, Marcello (Columbia University)

Presenter: Dr MESSINA, Marcello (Columbia University)

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