DNP12-2012-020044

Abstract for an Invited Paper
for the DNP12 Meeting of
the American Physical Society

TPC Detectors for Neutrino-less Double-Beta Decay and Dark Matter Searches

AZRIEL GOLDSCHMIDT, Lawrence Berkeley National Laboratory

Time Projection Chambers (TPCs) are increasingly becoming the particle detector technology of choice for rare event searches such as neutrino-less double beta decays and direct WIMP dark matter interactions. At present time, experiments using xenon-filled TPCs are producing some of the best limits for both of these searches. TPCs offer 3D ionization-track imaging as well as calorimetric energy measurements both of which are important handles for the identification of the rare sought-after events while discarding background events due to cosmic rays or due to radioactive decays in the detector or surrounding materials. Particle identification, beyond that provided by the particle range and dE/dx information, is also available from the relative amount of ionization and excitation losses and is essential for the WIMP searches. The contiguous gas or liquid volume at the heart of a TPC is continuously purified to remove contaminants that would otherwise deteriorate the detector performance or produce backgrounds. The fiducial volume for the event searches can be defined after the fact and is typically chosen to be well separated from the physical boundaries of the working gas or liquid to avoid surface events that often are problematic and much harder to reject in solid state detectors. The scalability of the TPC is one of its most important advantages in a field where ever increasing detector masses are required to achieve the required sensitivities. Detectors of O(100) kg scale are in operation and construction and ton to multi-ton detectors are being planned and expected to come on-line in the next years. In this talk I will describe the various types of TPCs in use or planned and will discuss their potential for achieving the exciting goals of discovering the dark matter particle and observing neutrino-less double beta decays.