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Investigation of the electric field uniformity in the ReD detector

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Dark matter remains one of the few fundamental problems of particle physics and cosmology that is not explained in the Standard Model (SM). Today, the direct search for dark matter results in a limitation on parameter space of mass and the spin-independent cross section of WIMP interaction.
For low mass WIMPs, the best results are shown by the noble liquid time projection chambers (TPCs). The signal in the LAr TPC is observed both from excitation, which results in a direct scintillation, and from ionization of argon. Part of the electron-ion pairs recombines, and the remaining free electrons are drifted towards the liquid surface, by an applying electric field, and are extracted into the gas phase. In the so-called gas pocket, electrons, further accelerated by a stronger electric field, excite the gas atoms producing a secondary scintillation via electroluminescence. The light components emitted in liquid argon and in gas are called ⊠1 and ⊠2, respectively. To accurately reconstruct the position of recoil events, it is necessary to know the exact parameters of the electric field in the TPK.
This work presents the results of modeling the drift field in TPC for the ReD experiment, aimed at nuclear recoil studies in a neutron beam at the INFN Laboratori Nazionali del Sud in Catania. To verify the accuracy of the simulation of the electric field in the chamber, a comparison of 2-dimensional modeling, made by the Comsol multiphysics package, with the semi-empirical formula [1] was conducted, the result of this study will be presented in this talk.

References:

1. F.H. Read, N.J. Bowring, P.D. Bullivant, & R.R.A. Ward (1999). Short-and long-range penetration of fields and potentials through meshes, grids or gauzes. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 427(1-2), 363-367.

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