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ReD: a SiPM based LAr TPC for directionality studies

The Recoil Directionality project (ReD) aims to characterize the light and charge response of a liquid argon (LAr) dual-phase Time Projection Chamber (TPC) to neutron-induced nuclear recoils. The main goal of the project is to probe for the possible directional dependence suggested by the SCENE experiment. Furthermore, ReD will have the possibility to study the response of a LAr TPC to very low-energy nuclear recoils.
ReD consists in the irradiation of a miniaturized LAr TPC with a neutron beam at the INFN, Laboratori Nazionali del Sud (LNS), Catania. Neutrons are produced via the reaction p(^{7}Li,^{7}Be)n from a primary ^{7}Li beam delivered by the TANDEM accelerator of LNS. A ΔE/E telescope, made by two Si detectors, identifies the charged particles (^{7}Be) which accompany the neutrons emitted towards the TPC. The core detector of ReD is a small custom-made double phase LAr TPC, having sensitive volume of $5 \times 5 \times 5$ cm^3. The ReD TPC uses all the innovative features of the DarkSide-20k design: in particular the optoelectronic readout based on SiPM and the cryogenic electronics. It is thus a valuable test bench of the technology which is being developed for DarkSide-20k and for the future project Argo. Neutrons scattered from the TPC are eventually detected by using an array of nine 3-inch liquid scintillator (LSci) detectors. All LSci are placed such to tag recoils having the same energy, i.e. the same scattering angle with respect to the incident neutron, but different angle with respect to the drift field of the LAr TPC, thus allowing to search for a possible directional response.

The integration of the three detector systems was performed within two test beams on 2018, using the TANDEM accelerator of LNS. Neutrons were produced by sending a ^{7}Li 28 MeV beam onto a set of CH_2 targets having thickness between 150 and 250 μg/cm^2. The physics measurement is expected to take place during 2019. This contribution will report about the current status of the project and on the short- and medium-term plans.

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