



Contribution ID: 207

Type: Oral

The Recoil Directionality (ReD) experiment

Wednesday, 5 September 2018 18:00 (20 minutes)

Directional sensitivity to nuclear recoils would provide a smoking gun for a possible discovery of dark matter in the form of WIMPs. A hint of directional dependence of the response of a dual-phase liquid argon Time Projection Chamber (TPC) was found in the SCENE experiment. Given the potential importance of such a capability in the framework of dark matter searches, a new dedicated experiment, ReD (Recoil Directionality), was designed in the framework of the DarkSide Collaboration, in order to scrutinize this hint.

A small dual-phase liquid argon TPC is irradiated with neutrons produced by the $p(\text{Li7},\text{Be7})n$ reaction from the TANDEM accelerator of the INFN Laboratori Nazionali del Sud (LNS), Catania, such to produce Ar nuclear recoils in the range of interest for Dark Matter searches. Energy and direction of nuclear recoils are inferred by the detection of the elastically-scattered neutron by a set of scintillation detectors. Golden scattering events can be further selected by gating of the associated Be7, which is detected by a telescope made of two Si detectors. As an additional valuable by-product, ReD can be operated to study the response of the TPC to very low-energy nuclear recoils (in the keV range).

After a commissioning phase of the TPC at INFN Naples, the ReD set-up was deployed and integrated on a beam line of the LNS. Initial beam time was granted in June-July 2018, allowing for the first characterization and for the integration of the three detector systems (TPC, liquid scintillators, Si telescope).

This contribution will describe the performance of the detectors achieved during the first test-beam, the current status of ReD and the perspectives for physics measurements during the forthcoming beam-time.

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Session Classification: direct search for DM and underground experiments