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Characterization of low-energy Argon recoils with the ReD experiment

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The Recoil Directionality project (ReD) within the Global Argon Dark Matter Collaboration aims to characterize the response of an argon dual-phase Time Projection Chamber (TPC) to neutron-induced nuclear recoils (NRs) and to measure the charge yield for low-energy recoils. This measurement is crucial to improve the sensitivity of future low-mass studies. The charge yield is a critical parameter for the experiments searching for dark matter in the form of low-mass WIMPs and measurements in Ar below 10 keV are scarce in the literature. ReD was designed to cover this gap, by irradiating a miniaturized TPC with neutrons produced by an intense Cf252 fission source, to generate Ar recoils in the energy range of interest. Data were collected during the Winter of 2023 at the INFN Sezione di Catania. The energy of the nuclear recoils produced within the TPC by (n,n') scattering was determined by detecting the outgoing neutrons by a neutron spectrometer made of 18 plastic scintillators. The neutron kinetic energy was evaluated event-by-event by using a time-of-flight approach. The ionization signal was measured for Ar recoils down to 2 keV.

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