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Time Projection Chambers instrumented with resistive Micromegas for the SAND near detector of DUNE

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The Deep Underground Neutrino Experiment (DUNE) is a next-generation long-baseline neutrino accelerator experiment. It aims for precise measurements of the neutrino oscillation parameters, in particular the violation of the charge-parity symmetry and the neutrino mass hierarchy. DUNE consists of a Far Detector (FD) complex with four multi-kiloton liquid argon detectors, and a Near Detector (ND) complex located close to the neutrino source at Fermilab (USA).
The ND complex regroups three different detectors among which SAND (System for on-Axis Neutrino Detection) will be the only one permanently on the neutrino beam axis.
The main purpose of SAND is to monitor in detail the emitted neutrino beam and its stability through time, a crucial characteristic to realize accurate oscillation measurements at the percent level.
SAND will reuse the superconducting magnet and the electromagnetic calorimeter of the KLOE experiment. There are currently two different designs proposed for the inner tracker, which will be a fully new object.
One of the two consists of a large 3D matrix of 1.5cm side scintillator cubes (3DST) surrounded by 3 gaseous Time Projection Chambers.
This setup allows to realize accurate beam monitoring combining the 3DST unprecedented capability of neutron detection and energy measurement with the high precision momentum resolution for charged particles offered by the TPCs. The proposed TPC design allows to reach spatial resolutions of a few hundreds of micrometers using 1cm² pads thanks to the use of resistive Micromegas technology for the charge readout. Results of prototypes testing of Micromegas modules with cosmics and test beam data will be shown, together with the expected performances of the SAND TPCs based on simulation.

Reference to paper (DOI or arXiv)

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