Status of Texas Active Target (TexAT) detector

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Texas Active Target (TexAT) is being constructed at the Cyclotron Institute (see Ref. [1] for general outline of the detector). It is designed for measurements of the excitation functions for proton, deuteron and alpha particle elastic and inelastic scattering and transfer reactions such as (*d,p*), (*d,t*) and (*d,*^{3}*He*) in inverse kinematics using radioactive ion beams.

In 2016 all main hardware components of TexAT (the scattering chamber, vacuum and gas handling systems, supporting electronics) were set up and tested. The complete setup is shown in Fig.1. For details of the design see Ref. [1,2].

FIG. 1. Photograph showing the outside of the TeXAT.

The key element of TexAT is a Time Projection Chamber (TPC) with highly segmented Micromegas bulk detector [3], that was designed in collaboration with IRFU (Sacle, France). Following our design, two Micromegas detectors (PC-board with the embedded mesh) were fabricated at CERN and delivered to Cyclotron Institute in the Fall of 2016. The active area of PC board is 246mm x 224mm and the total number of readout channels is 1024. The detailed design is described in ref.[2].

One of the Micromegas detectors was set up in custom designed Gas- box and tested with a ^{55}Fe *X*-ray source at argon/methane gas (P-5) mixture at atmosphere pressure. The photo of Gas- box test setup is shown in Fig.2.

FIG. 2. Gas-box (left panel) and test setup (right panel) for Micromegas detector.

The second Micromegas was mounted inside the TexAT scattering chamber and was tested in real TPC-mode with alpha-source in the atmosphere of methane gas (50 torr). To avoid contamination with dust all manipulations with bulk detectors were performed in the clean room.

The transparent field cage, that generate the uniform electric field for the time projection volume was designed for TexAT. The field cage has dimentions of 350mm x 320mm x 135mm. The electric field is created by equipotential set of wires, stretched along the walls. It creates a uniform electric field within the tracking area of Micromegas detector. The pitch between wires is 5 mm, and the electric potential is

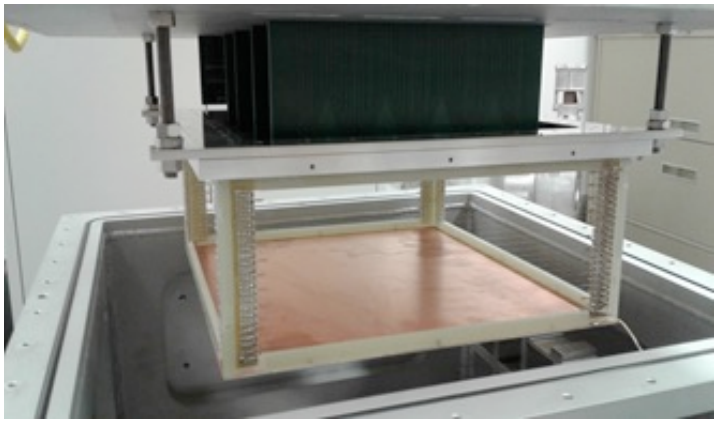

FIG. 3. TPC detector: field cage and Micromegas detector with connected readout ZAP- boards.

distributed between wire planes by the set of serial resistors (1 MOhm, 0.5%). The TPC detector (field cage and Micromegas detector) are shown in Fig.3.

In full configuration the TPC volume is suppose to be surrounded by an array of 50 Si detectors backed with an array of up to 50 CsI detector covering the solid angle of about 3π providing high efficiency for experiments with low intensity exotic beams.

The single sided, square design, 4 quadrants (25mm x 25mm), 1mm thick silicon detectors were chosen for TexAT project. The detectors are based on MSQ25 MicronSemiconductors design. However, to achieve lower price per detector unit, we are developing the process to produce these Si detectors in house. Ten MSQ25-type Si detectors are available for TexAT project at present.

Scintillator array is composed of square face (50mm x 50mm), 40 mm thick CsI(Tl) scintillator from SCIONIX (Holland). They have built-in PiN diode photo-readout and preamplifiers. These detectors are used to identify and measure residual energy of light particles that penetrated through the silicon (i.e. protons with an energy more then 12 MeV). Moreover, in some experiments they can be used to measure γ-rays.

Scintillation detectors (40 total) were tested with alpha- and gamma- sources. The energy resolution at the level of 4 to 5% for alpha- particles and of 6 to 7% for gamma- rays was demonstrated.

A commissioning run with the reduced setup – only 10 Si detectors at forward angles (Fig. 4) is planned for August of 2017.

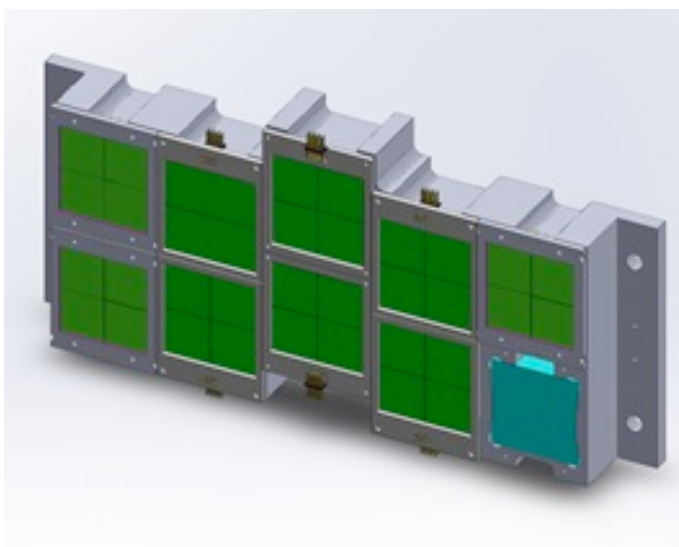

FIG. 4. "Forward"- wall (one Si-detector has been removed in order to show backing CsI(Tl).

[1] G.V. Rogachev, E. Koshchiy, E. Uberseder, and E. Pollacco. *Progress in Research*, Cyclotron Institute, Texas A&M University (2014-2015), p. IV-42.

[2] G.V. Rogachev *et al. Progress in Research*, Cyclotron Institute, Texas A&M University (2015-2016), p. IV-50.

[3] Y. Giomataris *et al.*, Nucl. Instrum. Methods Phys. Res. **A376**, 29 (1996).