Status of Texas active target data manager development

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In order to address questions in nuclear structure, nuclear reactions and nuclear astrophysics, Texas Active Target (TexAT) detector system is developed and commissioned at the Cyclotron Institute [1]. The system includes a Micro-MEsh Gaseous detector system (”micromegas”), a Silicon detector array and a CsI(Tl) detector array as shown in Fig. 1. It enables a time projection chamber (TPC) which provides 3D particle track information and measures its total energy deposition in Si and CsI(Tl), if particle escapes the active TPC volume.

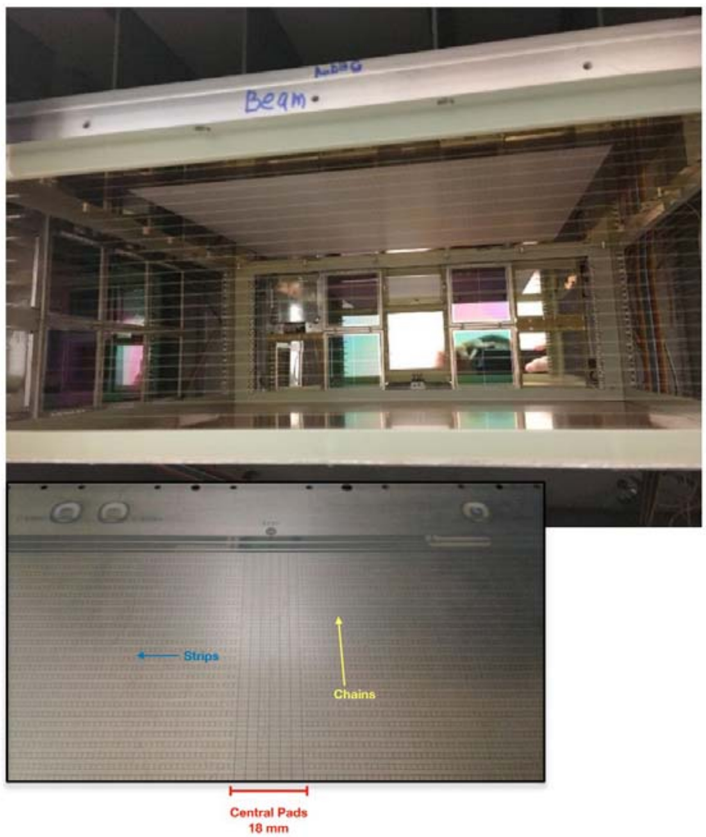

FIG. 1. A picture of TexAT detectors (top) and details of the Micromegas plate (bottom). The Micromegas plate is installed on top of the field cage. The Silicon detector array is surrounding the field cage to detect light particles from reactions and the CsI(Tl) detectors are placed at the back of the Silicon detector array to detect silicon-punch-through particles.

The readout of signals from the TPC is processed by the General Electronics for TPC (GET) [2] handling about 1300 total number of channels. The TexAT setup for an experiment is shown in Fig. 2. The GET electronics for the TexAT detector consists of 1 microTCA crate, 1 Mutant trigger module, 2

FIG. 2. A photo of TexAT full setup for an experiment with RIB beam. AsAd motherboards are placed on top of the TexAT chamber.

CoBo com- munication modules and 6 AsAd motherboards. Each AsAd motherboard includes four Application Specific Integrated Circuit (ASIC) chips (named as "ASIC for GET" or AGET chips) performing signal processes such as charge sensitive amplifier, shaping amplifier, analog digital converter, leading edge discriminator. Photos of the electronics are shown in Fig. 3. Digitized waveforms of signals are transferred from the AsAd boards to a computer storage by Ganil Data Acquisition System

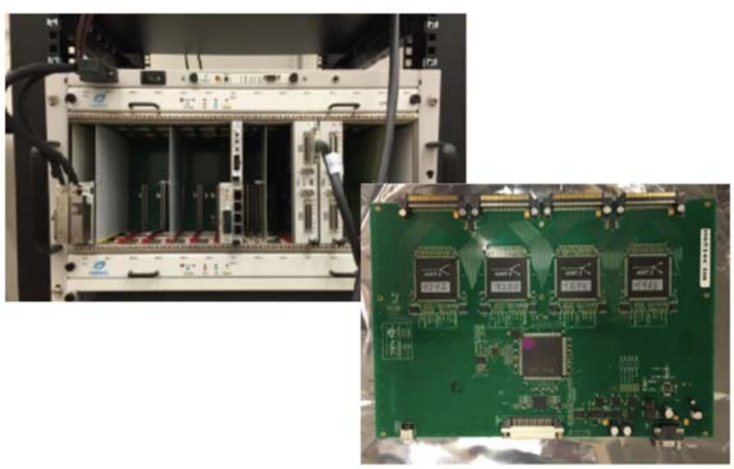

FIG. 3. Pictures of Cobo module in the TCA crate (left) and AsAd motherboard containing 4 AGET chips(right).

(Ganil DAQ) [3]. The Ganil DAQ has basically four main functionalities:

1. an electronics slow control for Mutant, CoBo, AsAd and AGET,
2. a run control manager for DAQ users to control and monitor data streams,
3. data transfer between electronics and the data storage,
4. data analysis tool (online and offline).

The implementation of the Ganil DAQ has been completed to the GET electronics for the TexAT system and users can conveniently manage and access stored data during experiments. An example snapshot of the DAQ system is shown in Fig. 4.

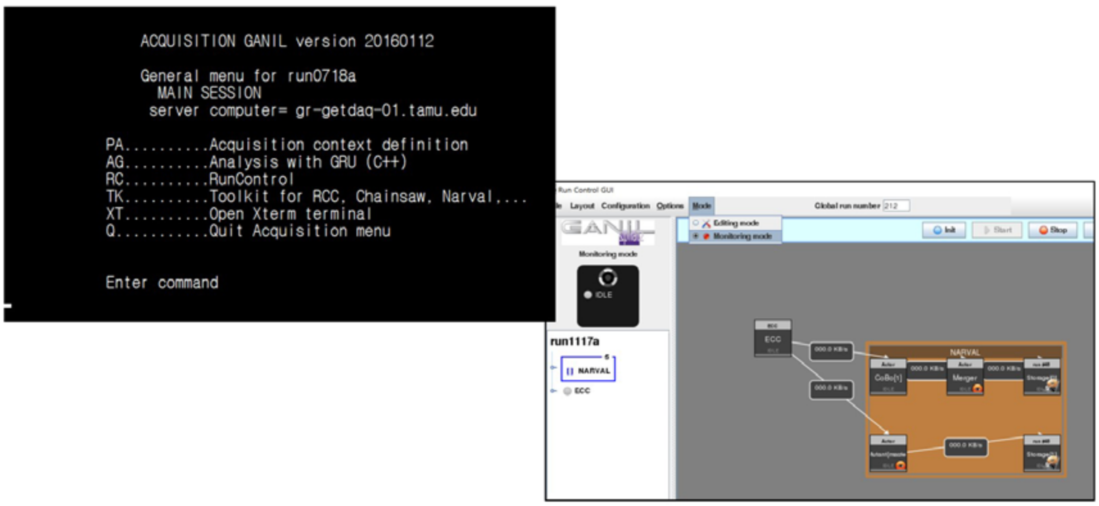

FIG. 4. Main menu of the Ganil DAQ (left) and run control GUI (right). In the menu, one can launch/restart a run control server, a run logger and so on. User can define number of electronics to use, initialize/reset the GET electronics, start/stop taking data and monitor data rate during runs with the GUI.

As mentioned above, data from the detector can be analyzed by a newly developed online/offline analysis tool, named as MFMHistServer, using libraries of Ganil DAQ software. The data analysis process has been performed with two tasks, one for data format conversion (from MFM to ROOT format) and another for visualization of data. Fig. 5 shows an example of waveforms read by a data diagnostics tool, cobo- frame-viewer, on the left. The MFMHistServer creates histograms and runs a histogram server to provide spectrum to a client program, vigru, which visualizes them for users. As data is analyzed and histograms filled by the MFMHistServer, the software, vigru, can update spectrum (similar to web server and web browser communication). Fig. 5 shows a snapshot of the vigru software. The MFMHistServer can read data from either online buffer stream or recorded data files, and online analysis function is very useful for troubleshooting of detector setup.

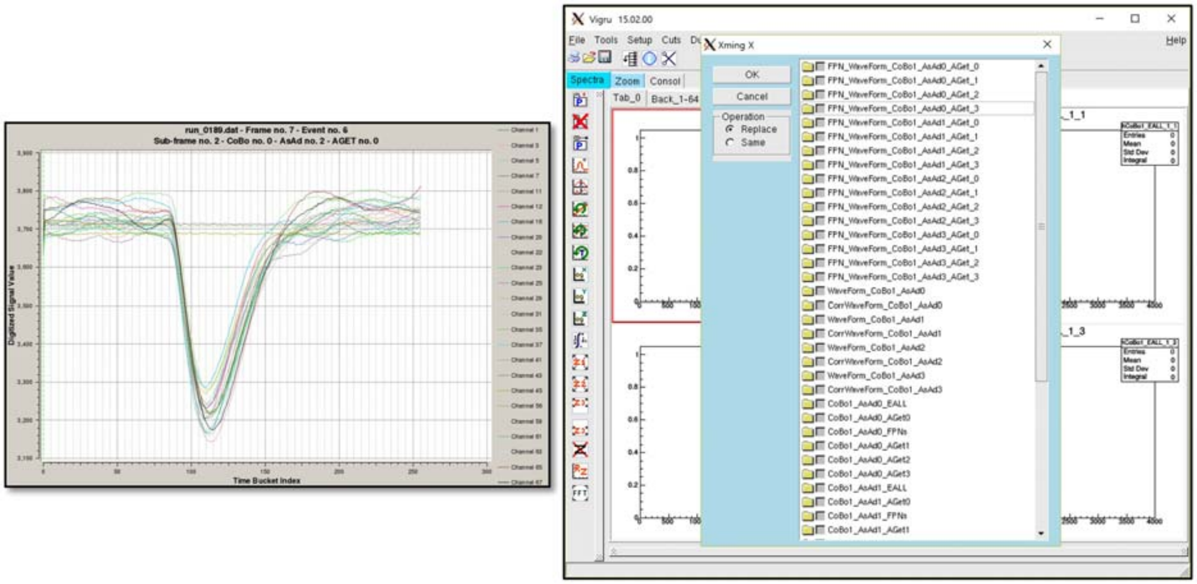

FIG. 5. An example of signal waveform data (left) and a screenshot of histogram visualization software (vigru) on the right. Total time length of the waveform is about 20 μs.

The MFMHistServer can also reconstruct particle tracks from hit pattern of Micromega plate. By per- forming the Hough Transformation method [4], one can find a slope and offset value of linear track as shown in Fig. 6. Alpha particle tracks from a source reproduced very well, as is evident in Fig. 7. Track

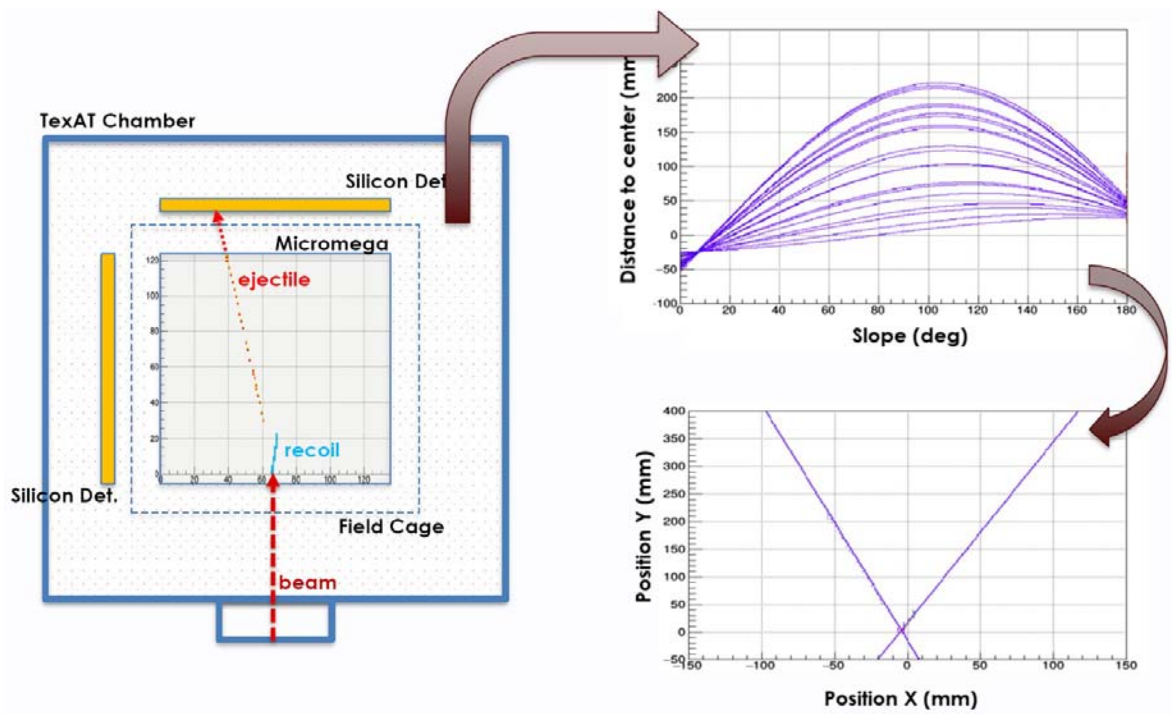

FIG. 6. An example of track reconstruction from the hit pattern of Micromega plate. From the track hit pattern (left), a 2D plot in the Hough parameter space can be drawn (top right) and the most focused point in the graph is picked for the slope and offset of the track. The bottom right graph shows two tracks found by the transformation method in two independent regions, respectively.

reconstruction for two body reactions is somewhat less reliable at the moment and improvements to track reconstruction are still being made.

In summary, the data manager for the TexAT active target detector system has been developed and already used for several experiments with beam rare isotope beams from Momentum Achromat Recoil Separator (MARS). The Ganil DAQ system is implemented in the TexAT GET electronics, to manage run controls and record data of digitized waveforms. In order to analyze online/offline data, the MFMHistServer has been developed and this provides a benefit of online data validation as well as a reconstruction of particle tracks.

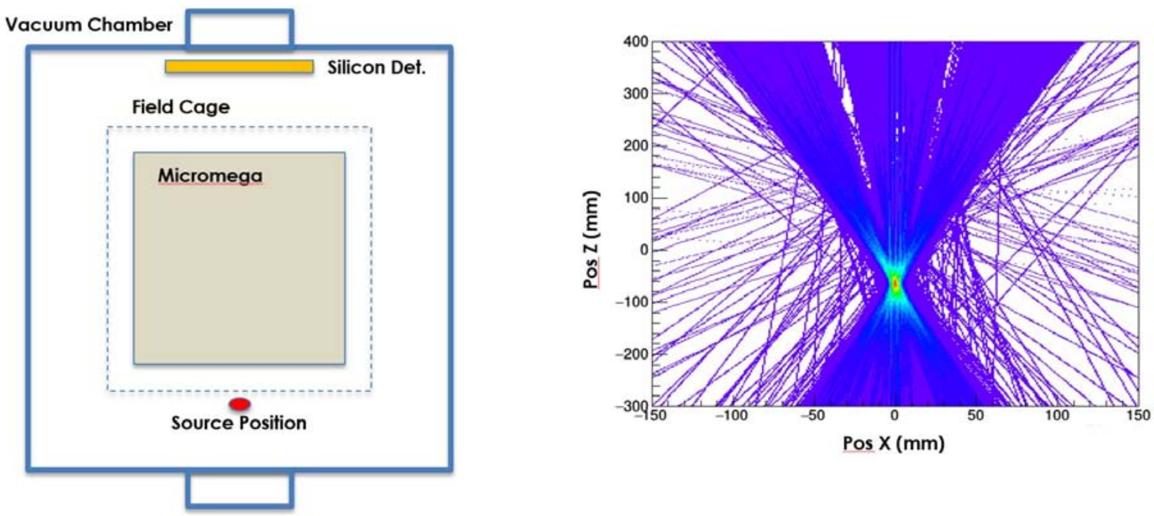

FIG. 7. Accumulated reconstructed tracks for alpha particles from the 241Am source. It shows the Hough transformation method works very well for one track per event.

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[3] A. Boujrad and F. Saillant, *2000 IEEE Nuclear Science Symposium*, Conference Record (Cat. No.00CH37149), Lyon, 2000, pp. 12/192-12/193 vol.2.
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