

6 - 2 Study of CEE-TPC 1/2 Principle Prototype

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Heavy ion collision experiments are one of the important means to study the properties of nuclear matter. The CSR External-target Experiment (CEE) is a low-temperature, high-density nuclear matter measurement spectrometer used for heavy ion collision experiments, and it will become the first large-scale nuclear physics experimental facility in China to operate in the GeV energy range after its completion. TPC (Time Projection Chamber) in the CEE is placed in the central area of the superconducting secondary magnet, which is used to measure the 3-D track of the charged particle products in large angle area and identify different particles^[1]. During the initial stages of development, the CEE-TPC 1/2 principle prototype was created to tackle numerous technical challenges in the development process, such as mechanical design, low material requirements, ensuring safe and stable application under ultra-high pressure conditions, and so on. Figure 1 shows the physical diagram of CEE-TPC 1/2 principle prototype.

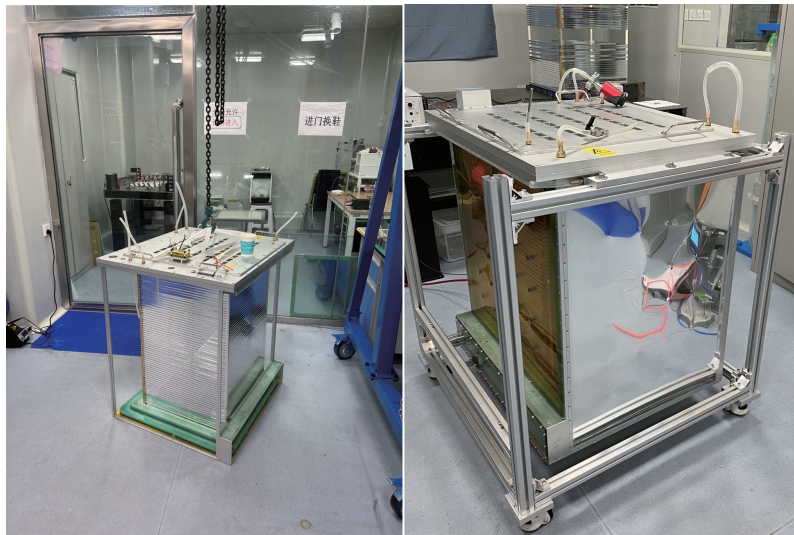


Fig. 1 (color online) Photo of CEE-TPC 1/2 principle prototype.

Combining the TPC development technology during the planning phase, the various components of the CEE-TPC 1/2 prototype were developed and the cosmic ray testing of the detector was completed with AGET electronics system. And in the process of testing, Ar/90% + CO₂/10% mixture gas was used, and the experiment was carried out in flow mode at LZC atmosphere pressure. The results show that the drift field is 300 V/cm, and the working voltage of the drift electrode is 26 800 V.

Figures 2 and 3 show the cosmic-ray event detected by the 1/2 prototype and the test results of cosmic rays with

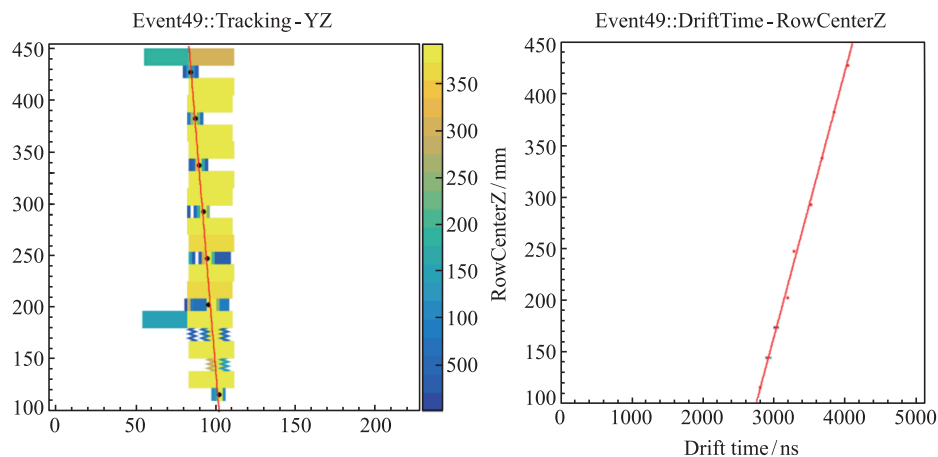


Fig. 2 (color online) Examples of cosmic-ray detected by the detector.

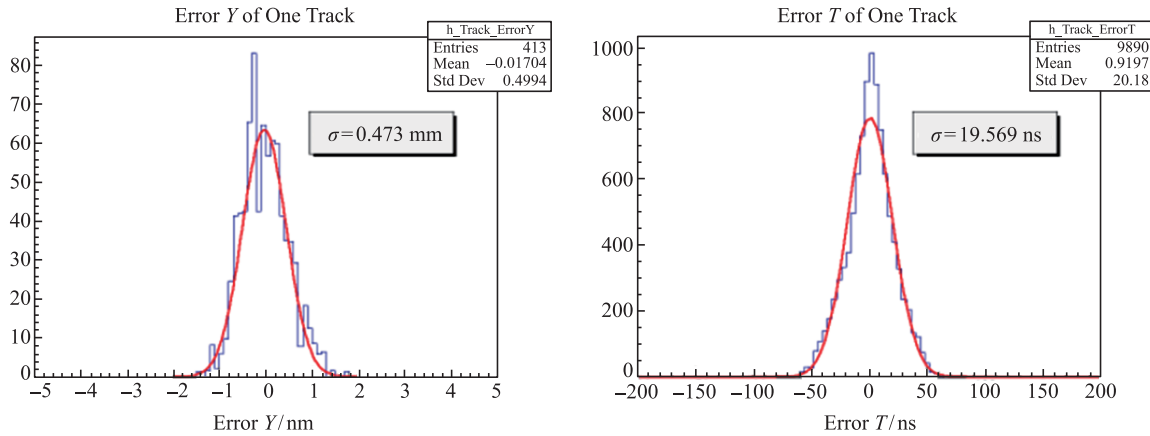


Fig. 3 (color online) Space resolution of the detector with cosmic-ray testing.

the track for pad plane of the drift time and the time resolution of drift direction. On the readout pad plane, the prototype achieved a position resolution of 473 μm for cosmic ray tracks and a position resolution of 19.9 ns in the drift direction.

Reference

[1] D. R. Nygren, J. N. Marx. Phys. Today, 31, 10(1978)46.

6 - 3 Energy Response of Detector in Pulsed Neutron Field

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In this work, simulation analyses were carried out using Monte-Carlo MCNPX code to obtain the energy response of silver detector, which is used in pulsed radiation fields as well as in continuous radiation fields with neutron energies ranging from thermal up to 5 GeV. The detector consists of two silver-covered plastic scintillators and two tin-covered plastic scintillators, which are arranged tightly with a photomultiplier tube, and surrounded with four spherical layers. The silver-covered plastic scintillators and the tin-covered plastic scintillators are placed in a compact and symmetrical way. Besides, signals of tin-covered plastic scintillators are subtracted from those of silver-covered plastic scintillators in order to eliminate the photon sensitivity for the neutron measurements. The working principle of silver detector is summarized by the following two reactions:

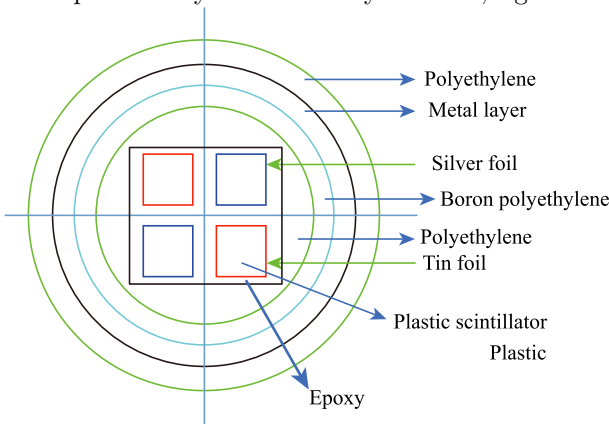


Fig. 1 (color online) The structure diagram of silver detector.

The working principle of silver detector is summarized by the following two reactions:



The silver detector has the advantage of reducing the impact of dead time in pulsed radiation fields. In addition, it can be applied for continuously monitoring and recognize the change of neutron dose level in few seconds. The silver detector has been processed and is now waiting for experimental testing. The structure diagram of this detector is shown below.

References

[1] Abdulah Mohammad Shehada, Valery Pavlovich Krivobokov, Radiation Physics and Chemistry, 189(2021)109732.
 [2] M. Luszik-Bhadra, E. Hohmann, Th. Otto, Radiation Measurements, 45(2010)1258.