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A TOF-tracker MRPC for simultaneous measurements of timing and position at the pi20 beamline of J-PARC

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In the Hadron Hall of J-PARC, we plan to measure the cross sections for exclusive Drell-Yan reaction ($e^-p \rightarrow e^+e^-n$) aiming to determine the generalized parton distribution functions (GPDs) of nucleons. The experiment will be conducted in the $\pi 20$ beamline and MRPCs will be utilized for muon identification. An area of $1.8 \text{ m} \times 2.4 \text{ m}$ will be covered by a MRPC that is designed to identify a muon pair from the Drell-Yan reaction. It is important to distinguish the desired muon pair from random combinatorial muons. For that purpose, we designed a MRPC that can measure timing and position simultaneously, which we call a TOF-tracker MRPC. We have designed 2-dimensional read-out strips for both zero-degree and 90-degree configurations. In the zero-degree read-out (X-direction), we utilize positive signals, while in the 90-degree configuration (Y-direction), we employ negative signals. The configuration is 1 stack, $0.26 \text{ mm} \times 5$ gaps, $500 \text{ mm} \times 1000 \text{ mm}$ active area, and a 5 mm of strip pitch. We conducted a beam test at the LEPS2 beamline in the SPring-8 facility. We achieved more than 99 % efficiency, 65 ps time resolution, and 0.8 mm position resolution. The results satisfy the performance requirements, which are 99 % efficiency, 100 ps time resolution, and 1 mm position resolution. However, we are facing a shortage of carbon sheets that we have been using for the HV electrodes. As an alternative, we are exploring the possibility of utilizing several kinds of polymer-based conductive coatings. The performance of the prototype TOF-tracker and the test results of alternative electrodes will be presented in this report.

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