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Development of fast-timing microchannel plate photomultiplier

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Planar microchannel plate photomultipliers (MCP-PMTs) with bialkali photocathodes are able to achieve single photon detection with excellent time (picosecond) and spatial (millimeter) resolution. They have recently drawn great interests in experiments requiring time of flight (TOF) measurement and/or Cherenkov imaging. The Argonne MCP-PMT detector group has recently designed and fabricated 6 cm x 6 cm MCP-PMTs. Atomic layer deposition (ALD) method is used to grow resistive and secondary emission layers to functionalize the glass capillary array. Initial characterization indicates that these MCP-PMTs exhibits a transit-time spread of 57 psec at single photoelectron detection mode and of 27 psec at multi photoelectron mode (˜100 photoelectrons). The MCP-PMTs were also tested at Fermilab test beam facility for its particle detection performance and rate capability, showing high rate capability up to 75 kHz/cm2, higher than the requirement for future electron-ion collider (EIC) experiment. A recent magnetic field test at ANL g-2 magnetic facility shows that the gain of MCP-PMT does not degrade until 0.75 Tesla, comparable to the current commercially available MCP-PMTs. Further improvement of its magnetic field performance is currently under developing by reducing the MCP pore size and spacing between inside components. The progress on the MCP-PMT development at ANL will be presented and discussed in the presentation.