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Performance of MCP-PMT and LAPPD in Magnetic Field for RICH Detectors

Various ring imaging Cherenkov sub-systems are being proposed in EIC detector for hadron identification with momenta up to 50 GeV/c. It is critical to have a reliable highly pixelated readout sensor working in the high magnetic field environment. Optimization of the photosensor design for high magnetic field tolerance, precision timing resolution, and pixelated readout was performed at Argonne National Laboratory with $6 \times 6 \text{ cm}^2$ microchannel plate photomultipliers (MCP-PMT). Large area picosecond photodetector (LAPPD) with $20 \times 20 \text{ cm}^2$ size was commercialized and the geometry was redesigned to reach the requirement of EIC Cherenkov detectors.

An Argonne MCP-PMT and two LAPPDs were recently tested using the Argonne g-2 magnet. Measurements of these devices' performance in the magnetic field will be discussed. The ANL MCP-PMT shows a performance of over 1.5 Tesla with $10 \mu\text{m}$ microchannels and optimized design. The LAPPD with $20 \mu\text{m}$ microchannels also show good performance up to 0.9 Tesla. Although gain was reduced when the magnetic field strength was increased to $\sim 1 \text{ T}$ or more, or tipped away from normal to the window, the gain could be recovered simply by increasing the MCP voltage. Data of LAPPD with $10 \mu\text{m}$ microchannels are still under analysis. Performance comparison of LAPPDs with 10 and $20 \mu\text{m}$ microchannels will be discussed in the talk.

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