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A SiPM-based optical readout system for the EIC dual-radiator RICH

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Silicon photomultipliers (SiPM) are candidates selected as the potential photodetector technology for the dual-radiator Ring-Imaging Cherenkov (dRICH) detector at the future Electron-Ion Collider (EIC). SiPM optical readout offers a large set of advantages being cheap devices, highly efficient and insensitive to the high magnetic field (~ 1.5 T) at the expected location of the sensors in the experiment. On the other hand, SiPM are not radiation tolerant and despite the integrated radiation level is expected to be moderate (< 10^{11} 1-MeV neq/cm2) it should be tested whether single photon-counting capabilities and the increase in Dark Count Rate (DCR) can be kept under control to maintain the optimal dRICH detector performance across the years.

Several options are available to maintain the DCR to an acceptable rate (below ~100 kHz/mm2), namely by reducing the SiPM operating temperature, using the timing information with high-precision TDC electronics, selection cuts based on bunch crossing information, and by recovering the radiation damage with high-temperature annealing cycles.

In this presentation we present the current status of the research and the first results on studies performed on a large sample of commercial (Hamamatsu) and prototype (FBK) SiPM sensors. The devices have undergone an irradiation campaign where an increasing NIEL dose up to 1011 1-MeV neq/cm2 has been delivered to different sensor subsets. The sensors have then undergone high-temperature annealing cycles to recover the radiation damage. The results obtained with a complete readout system based on the first 32-channel prototypes of the ALCOR ASIC chip are also reported.

In-person participation

Yes

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