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The SiPM readout plane for the ePIC-dRICH detector at the EIC: overview and beam test results

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The dual-radiator (dRICH) detector of the ePIC experiment at the future Electron-Ion Collider (EIC) will make use of SiPM sensors for the detection of the emitted Cherenkov light. The photodetector will cover ~ 3 m^2 with 3×3 mm^2 pixels, for a total of more than 300000 readout channels and will be the first application of SiPMs for single-photon detection in a HEP experiment. SiPMs are chosen for their low cost and high efficiency in magnetic fields (~ 1 T at the dRICH location). However, as they are not radiation hard, careful testing and attention are required to preserve single-photon counting capabilities and maintain the dark count rates (DCR) under control over the years of running of the experiment. DCR control can be achieved with operation at low temperature and recovery of the radiation damage via high-temperature annealing cycles. The exploitation of the SiPMs precise timing with fast TDC electronics helps reducing further the effect of DCR as background signal.

In this talk we present an overview of the ePIC-dRICH detector system and the current status of the R&D performed for the operation of the SiPM optical readout subsystem. Special focus will be given to recent beam test results of a large-area prototype SiPM readout plane consisting of a total of up to 2048 3×3 mm^2 sensors. The photodetector prototype is modular and based on a novel EIC-driven photodetection unit (PDU) developed by INFN, which integrates 256 SiPM pixel sensors, cooling and TDC electronics in a volume of $\sim 5\times5\times14$ cm^3. Several PDU modules have been built and successfully tested with particle beams at CERN-PS in October 2023 and in May 2024. The data have been collected with a complete chain of front-end and readout electronics based on the ALCOR chip, developed by INFN Torino.

Do you need a VISA letter for traveling to Canada ?

No

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