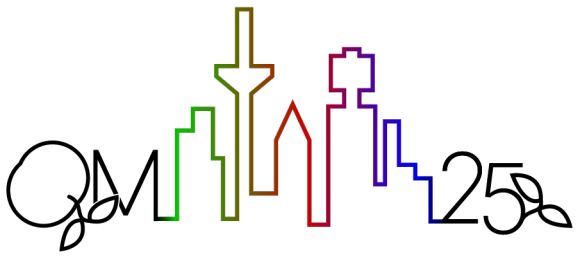

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The SiPM photodetector of the ePIC dual-radiator RICH at the EIC: overview and beam test results

The dual-radiator RICH (dRICH) detector of the ePIC experiment at the future Electron-Ion Collider (EIC) will make use of silicon photomultiplier (SiPM) sensors for the detection of the Cherenkov light emitted by particles crossing its radiators. The photodetector will cover $\sim$ 3 m^2 with 3×3 mm^2 pixels, for a total of more than 300k readout channels. This will be the first application of SiPMs for single-photon detection in a HEP experiment. SiPMs are chosen for their low cost and immunity to high magnetic fields ($\sim$ 1 T at the dRICH location). However, they are not radiation hard, demanding careful testing and attention to preserve single-photon counting capabilities and to maintain the dark count rates (DCR) under control over the years of running of the ePIC experiment. DCR control is achieved with operation at low temperature and recovery of the radiation damage via high-temperature annealing cycles. The exploitation of the SiPM precise timing with fast TDC electronics helps to reduce further the effect of DCR as background signal.

In this talk we present an overview of the ePIC-dRICH detector system, designed to provide continuous hadron identification in a broad momentum range from $\sim$ 3 GeV/c to $\sim$ 50 GeV/c in the forward region ($1.5 < \eta < 3.5$). The current status of the R&D performed for the operation of the SiPM optical readout subsystem will be reviewed. 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 $\sim$ 5×5×14 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.

Category

Experiment

Collaboration (if applicable)

ePIC-dRICH Collaboration at the EIC

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