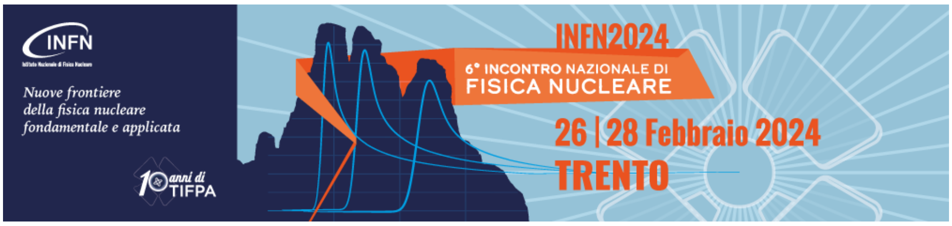

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Characterization of the photosensor and performance studies for the dRICH detector of the ePIC experiment at the future Electron-Ion Collider

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Silicon Photomultiplier (SiPMs) are solid-state photodetectors used for detecting light at the level of individual photons, employing avalanche multiplication as an internal gain mechanism. They have the advantage of high photon efficiency, excellent time resolution and are insensitive to the magnetic field. SiPMs are the baseline technology to equip the dual-radiator RICH detector (dRICH) of the ePIC experiment at the future Electron-Ion Collider (EIC).

We present the characterization of various types of SiPMs. Like many other detection devices, SiPMs are not immune to noise. One of the negative aspects of SiPMs is the presence of a Dark Count Rate (DCR), a phenomenon in which a SiPM generates electrical signals even in the absence of external interactions from particles or photons. This occurs due to the spontaneous thermal generation of electron-hole pairs in the semiconductor material of the detector. Such signals can be mistakenly interpreted as signals from incident light. Radiation damage is one of the main concerns when using these devices at accelerators. The effect of radiation on silicon detectors can be quite complex and depends on various factors, including the type of radiation, particle energy, radiation dose, exposure duration, as well as the specific characteristics of the detector itself. Irradiation can cause damage to the crystalline structure of the semiconductor material in the silicon photomultiplier (SiPM). These damages can increase the probability of generating free charge carriers, contributing to the increase in dark current and in DCR, as they can generate unwanted signals similar to those generated by incident light.

To estimate radiation damage in the sensors, they have been exposed to different radiation doses using the proton beam available at the Centro di Prontonterapia in Trento. These studies are essential to understand how to ensure optimal performance of the dRICH detector over an extended period, and consequently to confirm that SiPMs are the best sensors option for such detector. We will also discuss the separation of pions and kaons achievable with ePIC dRICH, exploring their dependence on particle momentum and selected pseudo-rapidity ranges. Finally, we will show how the resolution on the Cerenkov angle changes in the presence of noise.

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