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New Physics Studies at a Future Electron-Ion Collider Experiment: Study of Misalignment and Realignment for the High-Performance DIRC in Particle Identification

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The rich physics program at EIC reuqires excellent Particle Identification (PID) over a large momentum and angle range. Hence, a key component of the EIC detector ePIC are advanced ToF (Time of Flight) and Ring Imaging Cherenkov (RICH) detectors. In addition, a new type of Cherenkov detector will be used which is called high-performance DIRC (hpDIRC) detector. It utilizes internally reflected Cherenkov light to achieve precise hadron identification, particularly for pions (π) and kaons (K), ensuring clear separation of these particles for accurate measurements.
Tiny misalignments at the hierarchical or sensor level can degrade the detector's performance. This presentation explores the impact of realistic misalignment scenarios on Cherenkov angle accuracy and discusses strategies to mitigate these effects. We highlight the use of track-based realignment techniques, demonstrating that the hpDIRC can achieve over 4σ π/K separation up to 6 GeV/c, even under challenging alignment conditions. All studies are based on Geant4 Monte Carlo simulations using a standalone simulation framework including the hpDIRC geometry.

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