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Simulation studies related to the particle identification by the forward and backward RICH detectors at Electron Ion Collider

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The Electron Ion collider (EIC) will be the ultimate facility to address the internal dynamics played by the quarks and gluons to global phenomenology of the nucleons and nuclei. The essential physics programs greatly rely on an efficient particle identification (PID) in both the forward and the backward region. The forward and the backward RICHes of the EIC have to be able to cover wide acceptance and momentum ranges. In the forward region a dual radiator RICH (dRICH) is foreseen and in the backward region a proximity focusing RICH is foreseen to be employed.

The geometry and the performance studies of the dRICH have been performed and prescribed in the EIC Yellow Report. This prescription has been adopted in the ATHENA proto-collaboration detector scheme and has been integrated to the ATHENA software. The part of our work reports the effort following the call for EIC detector proposals. In this proposed design, as per prescriptions of the EIC Yellow Report, the forward and the backward RICHes cover wide acceptance and momentum range. In the forward region, dRICH performance showed a pion-kaon separation around 1 GeV/c to 50 GeV/c; whereas in the ATHENA scheme the backward region proximity focusing RICH (pfRICH) is designed with a 40 cm proximity gap is enhanced with filled C4F10 to use this RICH also in the threshold mode. This enables an electron-pion-kaon separation around 1 GeV/c to 10 GeV/c.

This contribution will give an overview of the simulation studies of the particle identification performance of both RICHes designed for the proposal of the ATHENA detector. A detailed description of the simulation chain in DD4Hep framework, the reconstruction of the single photon Cherenkov angle, the models of both RICHes, their performances, and technological synergies and the future plans will be addressed in this contribution.

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