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Design and Performance of an All-Silicon Tracker for the Electron Ion Collider

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State-of-the-art detectors are required to fulfill the challenging physics program of the future Electron-Ion Collider (EIC). Specifically, a hermetic, low-material-budget, compact tracker with excellent momentum and pointing resolution capabilities is needed. The experience gained with semiconductor detectors in previous colliders indicates that this technology is one of the best options to satisfy the EIC tracking requirements. We have designed and studied an all-silicon tracker prototype using the GEANT-based Fun4All simulation package. This tracker is hermetic for $|\eta| < 3.5$ and satisfies the projected material-budget requirements for an EIC tracker. Resolutions were studied by generating different particles from the nominal interaction point over the entire detector acceptance and up to momenta of 25 GeV/c and reconstructing them with the detector concept embedded in 1.4 and 3.0 T solenoidal magnetic fields. Jets resolutions were also studied from electron-proton collisions using the PYTHIA 8 event generator. We compared the momentum-resolution performance of the tracker with the requirements outlined by the EIC physics working groups and identified phase-space regions where the tracker out-performs the requirements. In regions where the requirements are more stringent than the tracker performance, we studied potential options to enhance the performance.

Primary author: Dr CRUZ TORRES, Reynier (Lawrence Berkeley National Laboratory)

Presenter: Dr CRUZ TORRES, Reynier (Lawrence Berkeley National Laboratory)

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