Contribution ID: **195** Type: **Posters**

Heavy flavor physics studies and silicon detector R&D for the future Electron-Ion Collider

Thursday 5 May 2022 12:49 (21 minutes)

The proposed high-luminosity high-energy Electron-Ion Collider (EIC) will provide a clean environment to explore the proton/nuclear structure, search for gluon saturation and precisely determine the nuclear parton distribution functions (nPDFs) in a wide x-Q^2 phase space. Heavy flavor hadron and jet probes at the future EIC will allow us to better constrain the nPDFs within the poorly constrained high Bjorken-x region, precisely determine the quark/gluon fragmentation processes and directly study the quark/gluon energy loss within the nuclear medium. We have carried out a series of simulation studies for heavy flavor hadron and jet production in $e+p$ and $e+A$ collisions with the latest EIC conceptual detector performances. These studies include reconstructed heavy flavor hadron and jet nuclear modification factor projections, nuclear modifications on the heavy flavor hadrons inside jets, and heavy flavor jet substructures. These measurements will provide a unique path to explore the flavor dependent fragmentation functions and energy loss in heavy nuclei, which can constrain the initial and final state effects for previous and ongoing heavy ion measurements at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC). A low material budget silicon vertex/tracking detector with fine spatial resolution (hit spatial resolution < 10 μm) is critical to carry out heavy flavor hadron and jet measurements at the future EIC. Fast timing capability (< 10 ns) helps suppressing backgrounds from neighboring collisions and provide precise particle identifications in the low transverse momentum region. Several advanced silicon technologies including the Low Gain Avalanche Diode (LGAD) and radiation hard Monolithic Active Pixel Sensor (MALTA) can meet these detector requirements. Progresses and results from the ongoing detector R&D for LGAD and MALTA will be presented as well.

Submitted on behalf of a Collaboration?

No

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Session Classification: WG4: QCD with Heavy Flavours and Hadronic Final States

Track Classification: WG4: QCD with Heavy Flavours and Hadronic Final States