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JLEIC forward detector design and performance

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The Electron-Ion Collider (EIC) is envisioned as the next-generation U.S. facility to study quarks and gluons in strongly interacting matter. The broad physics program of the EIC aims to precisely image gluons in nucleons and nuclei and to reveal the origin of the nucleon spin by colliding polarized electrons with polarized protons, polarized light ions, and heavy nuclei at high luminosity.

The Jefferson Lab EIC (JLEIC) design is based on a figure-8 shaped ring-ring collider. The luminosity, exceeding 10^33 cm^{-2}s^{-1} in a broad range of the center-of-mass (CM) energy and maximum luminosity above 10^34 cm^{-2}s^{-1}, is achieved by high-rate collisions of short small-emittance low-charge bunches made possible by high-energy electron cooling of the ion beam and synchrotron radiation damping of the electron beam. The polarization of light ion species (p, d, ^3He) can be easily preserved and manipulated due to the unique figure-8 shape of the collider rings.

The focus of this presentation is put on the forward detection capabilities of the JLEIC primary detector designed to provide essentially full acceptance to all fragments produced in collisions. The forward hadron detection is done in three stages: (1) fragments with scattering angles down to a few degree are detected in a 2m long end-cap, (2) fragments up to a few degree are detected after passing through a 1m long 2Tm spectrometer dipole in front of the final focusing quads (FFQs), and (3) fragments up to about one degree pass through the apertures of the FFQs and are detected in a 4m space before and a 16m space after a second 4m long 20Tm spectrometer dipole. On the forward electron side, the large-angle reaction products are detected in the second end-cap. Electron scattered at small angles are detected in a low-Q^2 tagger consisting of large-aperture electron FFQs and a spectrometer dipole with a few meters of instrumented space on either side.

The combination of a high luminosity, highly polarized lepton and ion beams, and detectors fully integrated with the accelerator will allow JLEIC a unique opportunity to make breakthroughs in the investigation of the strong interaction.

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