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Design Considerations for a High Luminosity Lepton Ion Collider[1]

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Studies are underway in the US to design a lepton-ion collider (EIC) with high luminosity (10^{-33} $cm^{-2}s^{-1}$)and high center-of- mass energy centered around the existing nuclear physics accelerators at either BNL or Jefferson Lab. EIC will be optimized for studying of the formation and structure of hadrons in terms of their quark and gluon constituents. For the RHIC-based collider, eRHIC, two options are under consideration, a more mature option based on a ring-ring concept with e^-/e^+-p and e^-/e^+-A collisions and a more ambitious design with a linac-ring architecture. Ions from the existing RHIC hadron ring will collide with 5-10 GeV electrons or positrons, either from a new electron/positron storage ring or a very high current cw electron linac. In both options, high current electron bunches in the polarized injector must be precisely synchronized with proton or ion bunches in the RHIC ring. The stacking option in the ring-ring design considerably reduces the required bunch charge from the polarized source. The polarized source requirements for the eRHIC linac-ring design are very demanding requiring sources capable of producing highly polarized cw currents of 200-300 mA. Another more futuristic option for Electron Ion Collider is being considered at Jefferson Lab (ELIC) based on the existing CEBAF superconducting linac, a new circulating electron ring and a hadron ring. The circulating figure-8 electron ring in this concept is intended to reduce the demanding high current injected polarized beam from the linac. In this paper, we present for the two options of eRHIC, the design considerations and requirements, and machine and polarized source parameters. The design considerations and machine parameters for ELIC will also be presented in this paper.

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