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Electron Ion Collider Accelerator Science and Technology - Designs, R&D and Synergies with European research in Accelerators

A U.S.-based Electron-Ion Collider (EIC) has recently been endorsed by the U.S. National Academies of Sciences, Engineering, and Medicine (NAS). This brings the realization of such a collider another step closer, after its earlier recommendation in the 2015 Long-Range Plan for U.S. nuclear science of the Nuclear Science Advisory Committee “as the highest priority for new facility construction following the completion of FRIB”. The connections between the scientific questions addressed at CERN and at the EIC as well as the shared interest regarding detector R&D are addressed in a separate submitted document “Synergies between a U.S.-based Electron-Ion Collider and the European research in Particle Physics”. There are, also, a large number of accelerator R&D topics that are associated with the US EIC that could be undertaken in collaboration that would be of enormous mutual benefit for European research centers and the US EIC.

An EIC will be an unprecedented collider that will need to maintain high luminosity ($10^{33-34} \text{ cm}^{-2} \text{ s}^{-1}$) over a very wide range of Center-of-Mass energies (20 GeV to ~ 100 GeV, upgradable to ~ 140 GeV), while accommodating highly polarized beams and many different ion species. Addressing the challenges of this machine requires R&D in areas such as crab cavities, energy-recovery linacs (for ion beam cooling), and high field magnets for the interaction points - areas in which U.S. and European centers are already investing in R&D, in many cases jointly.

A multi-laboratory collaboration is presently working on two site-specific EIC designs - eRHIC led by Brookhaven National Laboratory and JLEIC led by Jefferson Lab. While the designs are different, there are many common R&D issues on which eRHIC and JLEIC efforts are cooperating closely. The purpose of the present paper is to outline the status of the EIC accelerator designs and to discuss the most significant R&D subjects that have strong connection with developments in Europe, with the purpose of enlarging EIC collaboration both in physics and accelerator, to strengthen synergies with European accelerator projects, and - more generally - to maximize positive impact of fundamental science on society worldwide.

*) Submitted on behalf of Electron Ion Collider accelerator design team

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Primary authors: WILLEKE, Ferdinand (Brookhaven National Laboratory); SERGI, Andrei (Jefferson Lab)

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