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The Large Hadron electron Collider (LHeC) as a bridge project for CERN

The LHeC program elaborated in the CDR of 2021 included a first phase with concurrent operation of electron-hadron and hadron-hadron collisions at the HL-LHC, followed by a second phase of standalone electron-hadron collisions. In view of the current HL-LHC schedule, we propose an LHeC program extending the regular HL-LHC program with only a standalone electron-hadron operation phase. In this way, the LHeC becomes an impactful bridge project between major colliders at CERN. It is considered the last phase of the LHC and the first phase of a new flagship collider. The high-energy high-luminosity electron-proton collisions enable a multi-purpose experiment leveraging the HL-LHC proton beams. The data from the LHeC unlocks precision physics in the Higgs, Electroweak, QCD and top-quark sectors and specific searches for BSM physics. It further empowers the physics analyses at the HL-LHC by retrofitting measurements and searches with significantly more precise knowledge on the proton structure and the strong coupling. The accelerator technology deployed in the Energy Recovery Linac for the LHeC is a major stepping-stone for the performance, cost reduction and training for future colliders. The capital investments in the LHeC electron accelerator can be reused in a cost-efficient way as the injector for the FCC-ee. In addition, the data from the LHeC is an essential enabler for the physics potential of any new high-energy hadron collider. The operational plan of 6 years easily fits in the period between two major colliders at CERN. Similar to the LHeC empowering the HL-LHC physics program, the FCC-eh would be an impactful addition to the FCC physics program.

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