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Layout of the Interaction Region for Electron Proton Collisions in the LHeC and the FCC-eh Collider

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The LHeC and the FCC-eh projects study the design of future deep inelastic electron-proton colliders at CERN. In the LHeC, collisions between electrons and protons in the LHC interaction region IR2 will be established in parallel to the standard LHC operation: The e-p collisions will take place simultaneously with the experiments ATLAS, CMS and LHCb, while alternating with the ALICE experiment in IR2.

The electrons will be accelerated to a kinetic energy of 50 GeV in an energy recovery linear accelerator (ERL) positioned tangentially to the LHC and brought into collision with one of the 7 TeV proton beams of the LHC. The second proton beam of the LHC is guided through the interaction region with a minimal distance of 10σ to the colliding beams. The design luminosity of the LHeC of the order of $10^{33}\text{cm}^{-2}\text{s}^{-1}$ sets special requirements for the optics of the three beams, as the two proton beams of the LHC, as well as the electron beam will pass through a common interaction region.

First design studies of the optics and orbits of the three beam scenario in the LHeC have been performed to define the apertures and gradients of the required magnets. Different magnetic settings have been studied to establish a highly asymmetric beam optics for the colliding and non-colliding proton-beam in the LHeC in order to achieve the highest luminosity and machine performance and minimise the beam-beam interaction. The studied LHeC design will later be applied to the FCC-eh design, where an ERL is placed tangentially to the FCC, enabling collisions of 60 GeV electrons with 20 TeV protons.

Category

Particle / Astroparticle / Cosmology (Experiment)

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