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A very high energy electron-proton collider

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The possibility of a very high energy electron-proton (VHEeP) collider with a centre-of-mass energy of 9 TeV has been presented previously. Further developments are here discussed, summarising the results from a recent publication and highlighting opportunities for more investigation. At the VHEeP collider, with a centre-of-mass energy 30 times greater than HERA, parton momentum fractions, x , down to about 10^{-8} are accessible for photon virtualities, Q^2 , of 1 GeV^2 . The energy dependence of hadronic cross sections at high energies, such as the total photon-proton cross section, which has synergy with cosmic-ray physics, can be measured and QCD and the structure of matter better understood in a region where the effects are completely unknown. Searches at high Q^2 for physics beyond the Standard Model will be possible, in particular the significantly increased sensitivity to the production of leptoquarks. Other additional possibilities for future DIS experiments using a high energy electron beam accelerated using plasma wakefields are also discussed. Such beams could revitalise the field of DIS and investigate e.g. the proton density at very high x in fixed-target experiments.

Primary author: WING, Matthew (University of London (GB))

Co-author: CALDWELL, Allen Christopher (Max-Planck-Institut fur Physik (DE))

Presenter: WING, Matthew (University of London (GB))

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