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Proton-driven plasma wakefield acceleration for high-energy lepton beams

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Future colliders with discovery potential for particle physics rely on increasing the parton centre of mass (pCM) energy, with the recent P5 report calling for a 10 TeV pCM collider. However, the development of such schemes using conventional accelerator technology would result in ever larger facilities. High-gradient plasma wakefields driven by proton beams allow the transfer of energy to a witness bunch over a short length scale, and so offer a potential method to transform high-energy proton beams into high-energy lepton beams while requiring relatively little additional civil engineering.
The application of this concept to a Higgs factory driven by 400 GeV protons was recently proposed*. In the present work, we investigate the use of existing infrastructure to generate proton drive beams for plasma wakefield acceleration, with the goal of providing e+e- collisions with high luminosity in the TeV range. While there remain many challenges to realization of such a facility, the ability to make use of existing civil engineering makes this scheme extremely attractive.

Footnotes

- J. Farmer, A. Caldwell and A. Pukhov, New J. Phys. 26 113011 (2024).

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