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Physics Prospects for a near-term Proton-Proton Collider

Hadron colliders at the energy frontier offer significant discovery potential through precise measurements of Standard Model processes and direct searches for new particles and interactions. A future hadron collider would enhance the exploration of particle physics at the electroweak scale and beyond, potentially uniting the community around a common project. The LHC has already demonstrated precision measurement and new physics search capabilities well beyond its original design goals and the HL-LHC will continue to usher in new advancements.

This document highlights the physics potential of an FCC-hh machine to directly follow the HL-LHC. In order to reduce the timeline and costs, the physics impact of lower collider energies, down to ~ 50˜TeV, is evaluated. Lower centre-of-mass energy could leverage advanced magnet technology to reduce both the cost and time to the next hadron collider.

Such a machine offers a breadth of physics potential and would make key advancements in Higgs measurements, direct particle production searches, and high-energy tests of Standard Model processes. Most projected results from such a hadron-hadron collider are superior to or competitive with other proposed accelerator projects and this option offers unparalleled physics breadth. The FCC program should lay out a decision-making process that evaluates in detail options for proceeding directly to a hadron collider, including the possibility of reducing energy targets and staging the magnet installation to spread out the cost profile.

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