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The Linear Collider Facility (LCF) at CERN

In this paper we outline a proposal for a Linear Collider Facility as the next flagship project for CERN.
This proposal offers the opportunity for a timely, cost-effective and staged construction of a new collider that will be able to comprehensively map the Higgs boson's properties, including the Higgs field potential, thanks to a large span in centre-of-mass energies and polarised beams.
A comprehensive programme to study the Higgs boson and its closest relatives with high precision requires data at centre-of-mass energies from the Z pole to at least 1 TeV. It should include measurements of the Higgs boson in both major production mechanisms, ee -> ZH (Higgs-strahlung) and ee -> vvHH (WW fusion), precision measurements of gauge boson interactions as well as of the W boson, Higgs boson and top-quark masses, measurement of the top-quark Yukawa coupling through ee -> ttH, measurement of the Higgs boson self-coupling through HH production, and precision measurements of the electroweak couplings of the top quark. In addition, ee collisions offer discovery potential for new particles complementary to HL-LHC.
The facility we propose robustly satisfies these scientific goals.
With a total length of 33.5 km, two interaction regions as well as additional R&D and fixed-target experiments, it offers significant flexibility to take into account scientific and strategic developments.
From today's perspective, we propose to equip the Linear Collider Facility in a first stage with superconducting RF cavities for polarised ee collisions at a centre-of-mass energy of 250 GeV with a luminosity of 2.7×10^{34} $\mathrm{cm}^{-2}\mathrm{s}^{-1}$, which requires an investment of about 8.3 BCHF.
With a preparatory phase of six years, followed by ten years of construction, this first stage could start data-taking by 2042.
First upgrades comprise doubling of the luminosity for 0.8 BCHF and an increase of energy up to at least 550 GeV, which can be achieved with the same accelerator technology for about 5.5 BCHF.
Later stages will involve further increase of luminosity and energy as well as other new capabilities that will further enhance the Higgs programme and extend the discovery potential for new physics.
These upgrades will primarily be accomplished by accelerator technology innovations rather than by additional civil construction.

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