May 19, 2023

Statement on the Future of e^+e^- Higgs Factories from LCWS 2023

Scientists from many countries and regions are now gathered at the International Workshop on Future Linear Colliders (LCWS 2023) at the SLAC National Accelerator Laboratory. Together with colleagues from around the world, the linear collider community hereby issues the following statement:

1. Particle physics needs a new accelerator to measure the properties of the Higgs boson with high precision.

The Higgs boson is central to our understanding of the evolution of the Universe. It plays a critical role in all of the interactions studied in particle physics, and in the mysteries whose solution is central to progress in this field. Of all ways to search for physics beyond the Standard Model, precision measurements on the Higgs boson access the widest variety of new physics interactions. The "strong scientific importance" of precision Higgs measurements was emphasized in the 2014 P5 report in the US. The need for an e^+e^- Higgs factory as the next collider was called for in the 2020 update of the European Strategy for Particle Physics and in the Energy Frontier report from Snowmass 2021.

2. The particle physics community needs to realize the e^+e^- Higgs factory as soon as possible.

Data-taking at a future e^+e^- Higgs factory should follow the HL-LHC directly, requiring construction start by 2030, in parallel with HL-LHC data-taking. This will ensure that essential and unique expertise and human resources will remain available. A long delay will dissipate these resources and endanger the future of our field.

We recommend that the e^+e^- Higgs factory should be based on a linear collider. There are many advantages of the linear approach. Among these, linear colliders are able to access energies of 500 GeV and beyond. This will allow measurements that must be included in the search for new physics through precision, including measurement of the top quark mass and electroweak couplings, the top quark Higgs coupling, and the cross section for double Higgs production. Proposed linear collider Higgs factories are designed for greater compactness, energy efficiency, and sustainability, with correspondingly lowered construction and operation costs.

3. The realization of the Higgs factory requires immediate funding for both accelerator and detector R&D.

Operation of an e^+e^- Higgs factory on this timeline requires both accelerator and detector R&D on the scale needed to produce engineering designs. There are new developments in the ILC technology, leading to performance improvements and cost reductions. Further advances in ILC technology, as well as alternative technologies such as C^3 and CLIC, promise lower costs and/or extended energy reach for later stages of this program. These developments

need to be evaluated rigorously with dedicated R&D. Precision measurements of the Higgs boson and other heavy particles are challenging. The requirements call for a dedicated detector R&D program, bringing new ideas from the LHC and elsewhere to achieve the goal of measurements of ultimate precision. The new ILC Technology Network is an important first step toward this goal, but more is needed. The Higgs factory program needs to begin now.

4. The Higgs factory needs a definite plan for funding and construction.

We support the construction of the ILC in Japan as the most direct route to the Higgs factory physics program. At the same time, we are investigating other possible sites and technologies, for example, hosting by the US as suggested by the Snowmass Energy Frontier report, or in Europe. Whatever the site, the e^+e^- Higgs factory will need to be constructed as a global facility. We need to build the funding and governance agreements that will make this possible.

5. The e^+e^- Higgs factory is the bridge to our high-energy future.

For the future of particle physics, we look forward to exploring higher energies, with quark and lepton collisions at 10 times the energies of the LHC. New technologies are proposed, using pp, muon, and e^+e^- colliders. All of these will require decades of R&D. Construction and operation of a linear Higgs factory will contribute to this R&D, developing accelerator science, keeping all of these options open, and providing challenges to train young scientists. The new results will be relevant to all approaches for reaching higher energies and luminosities, and for applications beyond particle physics. Discoveries at a Higgs factory may point to specific goals for higher energy machines. The Higgs factory will serve as a bridge from the LHC to the future of high energy physics research.

6. We are committed to carrying out the precision Higgs measurements, which we consider the leading path toward further progress in particle physics.