International Linear Collider: Accelerator

Description: The International Linear Collider (ILC) is a high-energy, high-luminosity electron-positron colliding beam facility. It is a centerpiece in the world roadmap for particle physics. The discovery of a Higgs-like boson at the LHC motivates a strategy to build the machine to operate initially at a center-of-mass energy of about 250 GeV, followed by an increase in steps, to 350 GeV, 500 GeV and eventually to 1 TeV.

Science: The ILC will explore physics at the TeV scale, with capabilities that are unobtainable with any other facility. It will provide measurements complementary to those from the Large Hadron Collider (LHC), emphasizing precision measurements based on a well-controlled initial state in a low background environment. The design of the ILC and its detectors anticipated the discovery of a low-mass Higgs boson and provides an ideal instrument for measuring the full array of Higgs boson properties. These include the Higgs couplings to many fermions including charm, bottom, and top, the Higgs self-coupling, and the Higgs coupling to invisible particles such as dark matter. The ILC will add significantly to the LHC searches for new physics. The ILC has unique capabilities to discover weakly interacting particles that may be hidden in the backgrounds at the LHC. Through precision measurement of two-fermion production, W pair production, and top quark production, the ILC gives access to high mass scales, typically beyond the reach of LHC direct searches. Taken together, data from the ILC and the LHC will advance a deep understanding of electroweak unification. The ILC will thus have a major impact on our knowledge of the TeV scale and our models of higher mass scales.

Collaboration: After the 2004 decision to adopt SCRF technology for the ILC, a worldwide Global Design Effort was created by ICFA to advance the program. The GDE was the first fully international accelerator design effort, with partnership between Asia, Europe and the Americas. It was charged to conduct a 5-year R&D program to develop SCRF technology and achieve the gradient and yield goals; to demonstrate risk mitigating strategies; and to create a detailed conceptual design of a 500 GeV baseline machine, upgradable to 1 TeV. The design provides the basis of an international style value cost estimate, suitable for collaborative negotiations. In 2012, the GDE completed its program with successful demonstration of the 2006 goals and concluded that the technology for the project was in hand. The extensive technical design report (TDR) is presently under international review. The HEP community in Japan, with their government's concurrence, has proposed siting the ILC in Japan with a phased collision energy. This proposal aligns well with the European strategy. Details of the Japanese plan will be presented to the US community in summer 2013.

Cost and schedule: The GDE cost estimate comprises the component value and explicit labor, and omits items such as pre-construction, contingency, escalation, spare equipment, beam commissioning that would be included in US estimates. The value cost is ~$7.5B (2012) and ~22.5M man-hrs of labor for the total project. The current concept for the realization of the project has the US providing an in-kind contribution that has not yet been determined. Conversion of a value cost into US terms depends on the nature of the in-kind contributions. The schedule will depend on the project organization and funding profiles, but should be driven by civil construction in the central campus and Main Linac cryomodule production. The TDR assumptions lead to a nine year period from ground breaking to the start of beam commissioning.

Science Classification and Readiness: The project is absolutely central for understanding the fundamental constituents of matter and the forces operating among them. It will also be at the frontier of advanced technological development and international cooperation. The accelerator systems and associated technologies have undergone thorough R&D. The facility design is mature. The SCRF technology will find broad applications in other projects. The project is ready for an international decision for proceeding to a construction project.