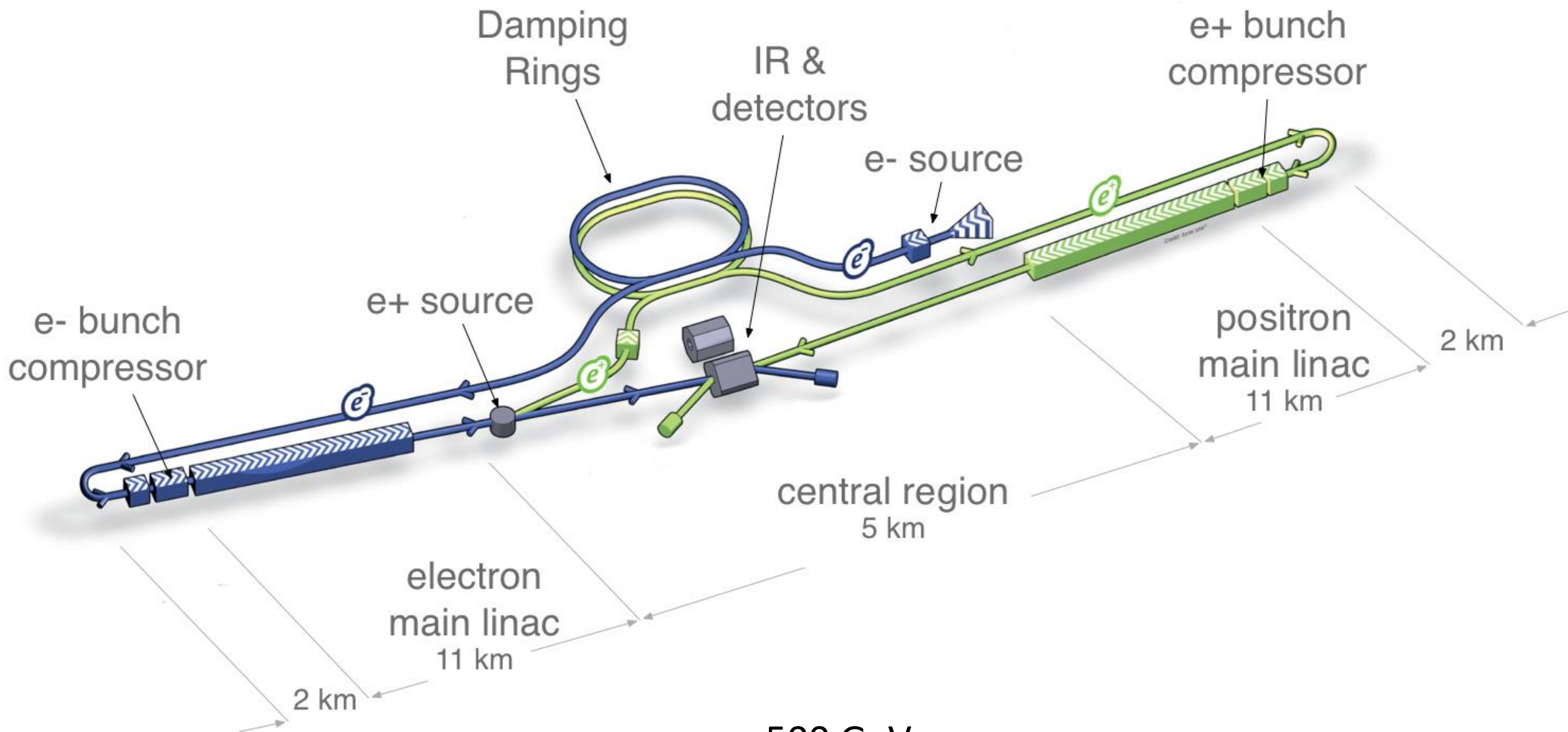
P5

Potential US Accelerator Collaboration with the ILC-in-Japan

Mike Harrison

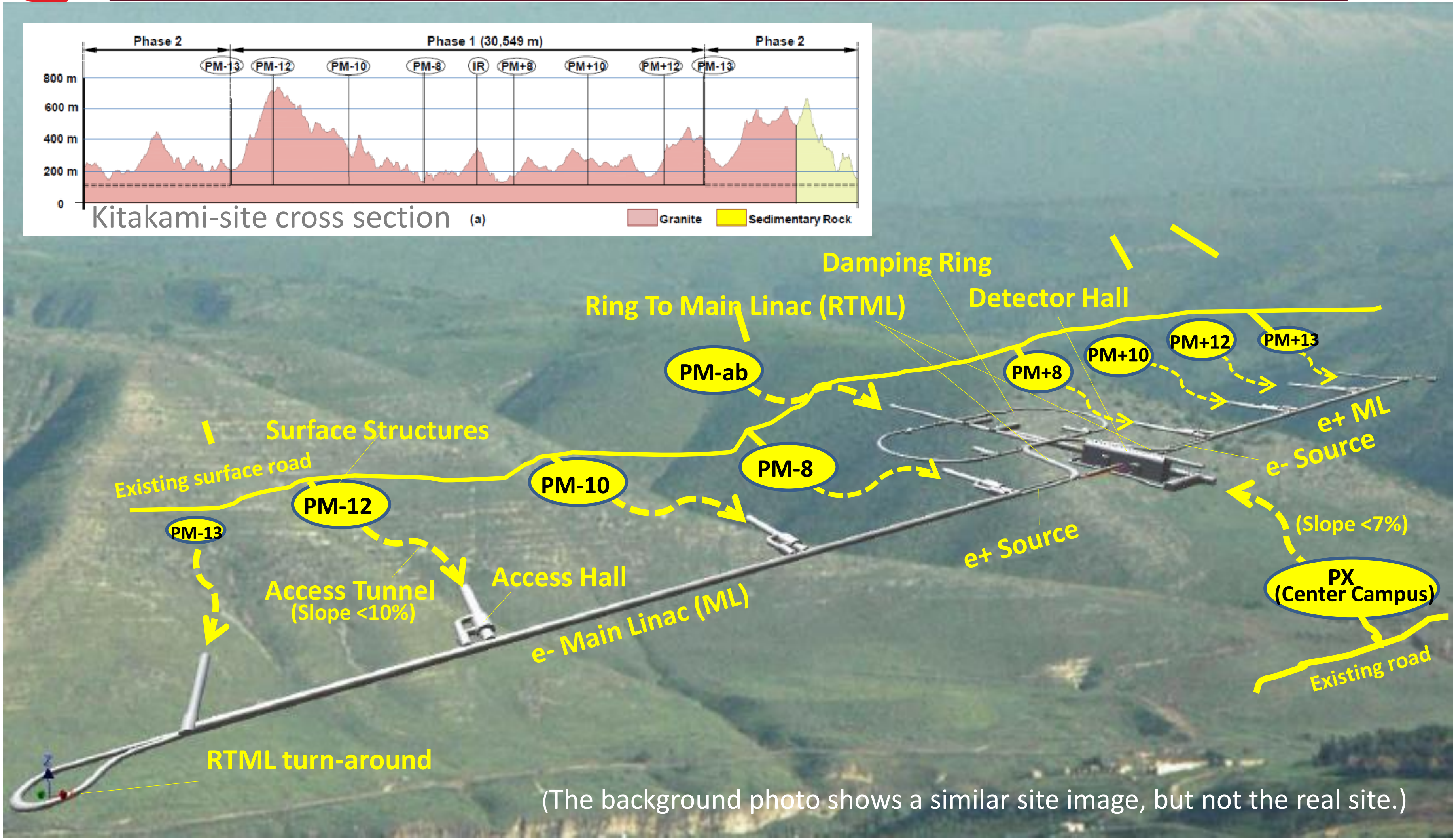
ILC Design – unchanged since the TDR



500 GeV

ILC Scheme | © www.form-one.de

Site Specific Design



Need to establish the IP and linac orientation
Then the access points and IR infrastructure
Then linac length and timing

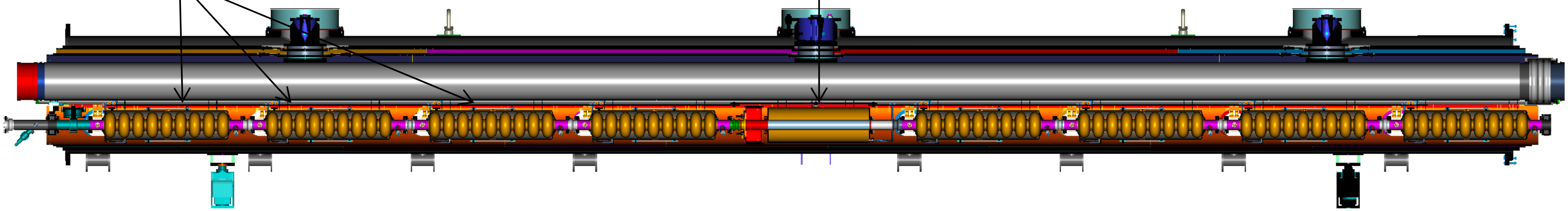
The Cryomodule

cavities (8)

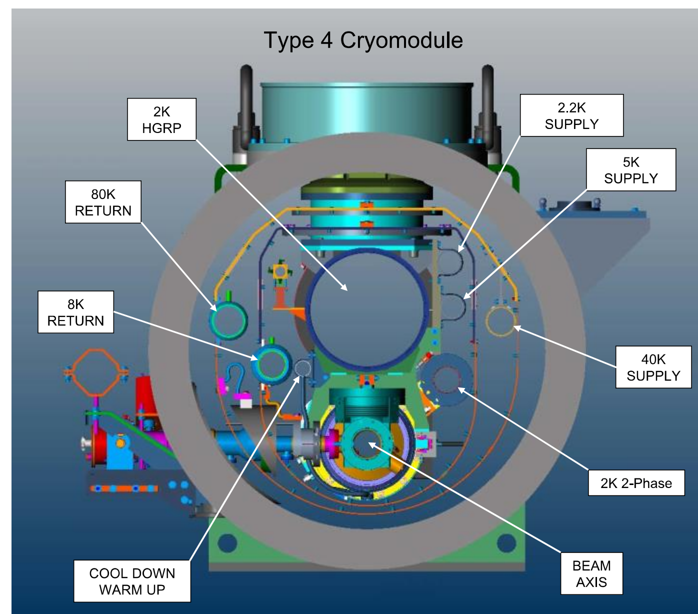
SC quad package

Type-B module

Type-A has 9 cavities and no quadrupole

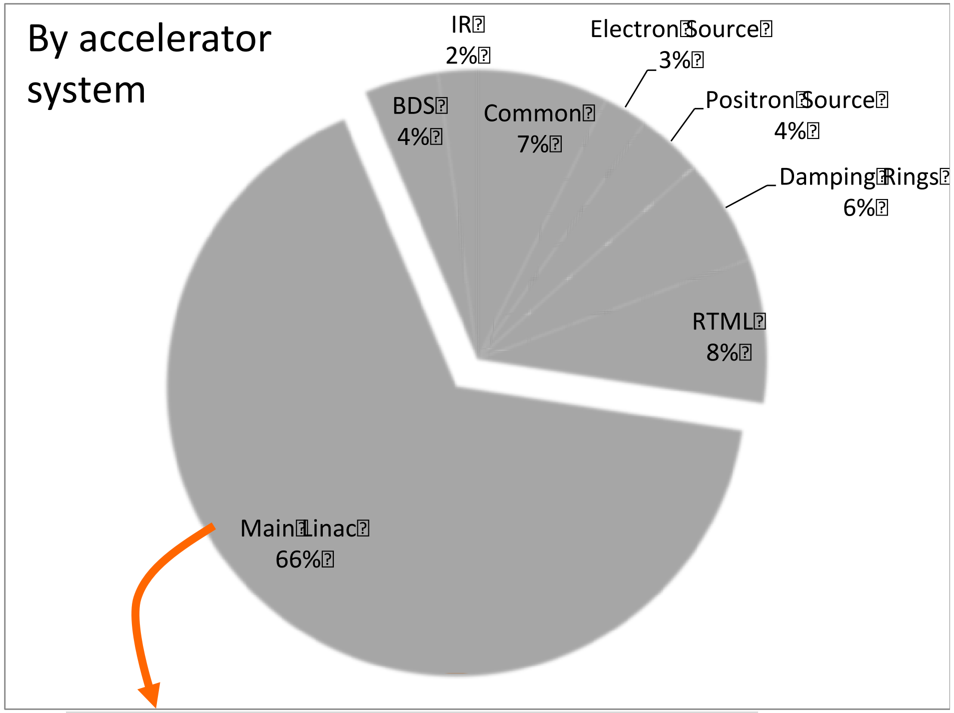


12.652 m (slot length)



LINEAR COLLIDER COLLABORATION

TDR Value Estimate 500 GeV

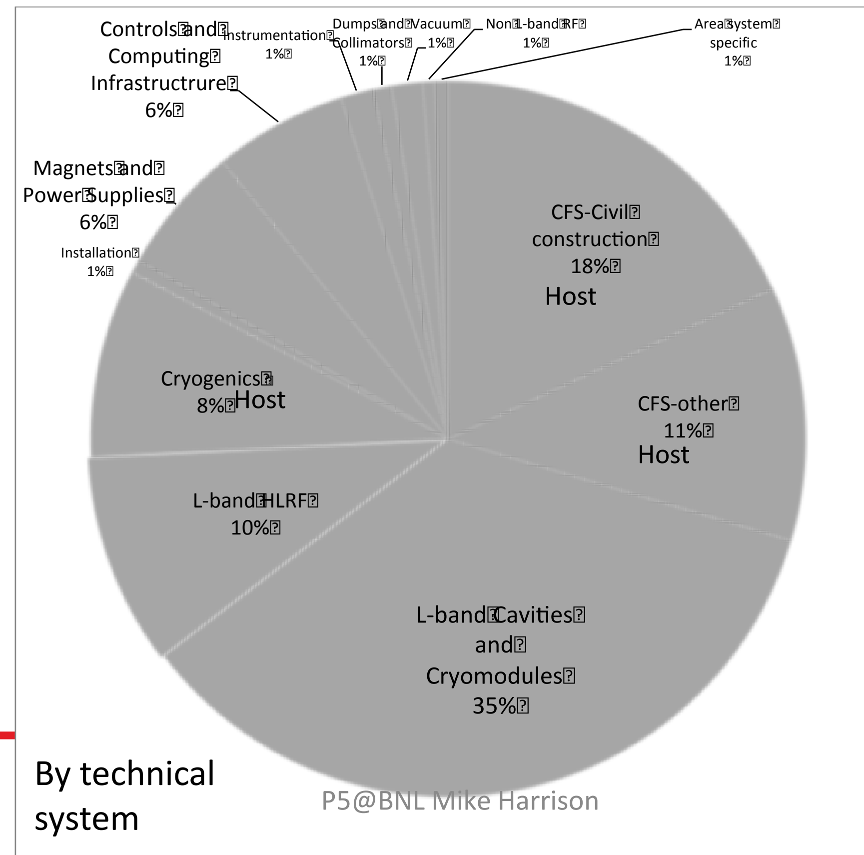


CFS-Civil construction	10%
CFS-other	6%
L-band Cavities and Cryomodules	32%
L-band HLRF	9%
Cryogenics	7%
Controls	2%
TOTAL Main Linac	**66%**

7.8 BILCU

ILCU = $FY12

Value estimate – no contingency, inflation, pre-ops, R&D, spares, etc….



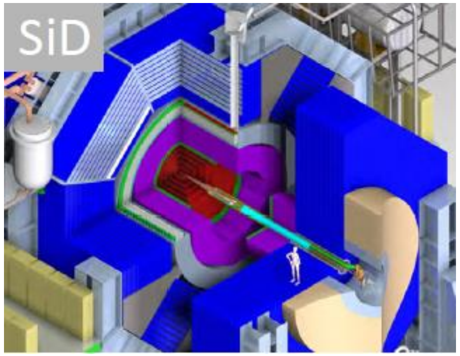
TDR Explicit Labour

Explicit labour estimates include the scientific, engineering and technical staff needed to plan execute and manage the technical systems including specification, design, procurement, vendor liaison, acceptance testing, QA, integration, installation and checkout.

Averaged over the different TDR sites this amounts to 22,448 K person-hrs.

Implicit labour such as cryomodule fabrication is included in the component costs.

Detector TDR Estimates



The validated detector concepts in the TDR showed value estimates done on the same basis as the ILC, and using common commodity costs (Si, Fe, W).

	SiD	ILD
Value cost (MILCU)	315	392 (336 – 421 depending on options)
Engineering (Man-yrs)	186	
Technical	532	
Administration	30	

US Involvement in the GDE R&D Program

There was significant ($35M/yr peak, $134M over 5 years) US involvement in the GDE program in both the technical design and technology development. SRF systems were ~ 66% of the total.

Electron source – SLAC & JLAB
Positron Source – ANL & LLNL
Damping Rings – SLAC & Cornell
Transfer Line & Bunch Compressor – Fermilab
Main Linac – SLAC & Fermilab
Beam Delivery System & Machine Detector Interface – SLAC & BNL

SRF High Gradient – JLAB, Fermilab & ANL, Cornell
SRF Cryomodules – Fermilab
SRF HLRF - SLAC

Which ILC ?

JAHEP statement Oct 2012

In March 2012, the Japan Association of High Energy Physicists (JAHEP) accepted the recommendations of the Subcommittee on Future Projects of High Energy Physics(1) and adopted them as JAHEP's basic strategy for future projects. In July 2012, a new particle consistent with a Higgs Boson was discovered at LHC, while in December 2012 the Technical Design Report of the International Linear Collider (ILC) will be completed by a worldwide collaboration.

On the basis of these developments and following the subcommittee's recommendation on ILC, JAHEP proposes that ILC be constructed in Japan as a global project with the agreement of and participation by the international community in the following scenario:

(1) Physics studies shall start with a precision study of the "Higgs Boson", and then evolve into studies of the top quark, "dark matter" particles, and Higgs self-couplings, by upgrading the accelerator. A more specific scenario is as follows:

(A) A Higgs factory with a center-of-mass energy of approximately 250 GeV shall be constructed as a first phase.

(B) The machine shall be upgraded in stages up to a center-of-mass energy of ~500 GeV, which is the baseline energy of the overall project.

(C) Technical extendability to a 1 TeV region shall be secured.

In what follows we shall only consider Phase 1 (~250 GeV). The model is a 250 GeV machine in a tunnel sized for 500 GeV. This is estimated at 5,846 MILCU and 19,050K person-hrs, i.e. about 75% of the TDR machine. It requires ~ 850 cryomodules.

Potential US Machine Involvement (1)

There is of course, no absolute criterion for inclusion in an in-kind contribution. The US industry/laboratory complex covers many technologies and skills necessary to complete a high-energy linear collider wherever it is located. There are however certain attributes that should be considered when assessing any particular contributions: unique (or world class) capabilities, strategic value to the domestic program, value to the project, and US industrial involvement.

Any US contribution will perforce involve a significant number of SRF cryomodules since the scope of the ILC will require the full capacity of the global community to meet the necessary production rate. The US cryomodule fabrication and test capacity resides at Fermilab and JLAB.

Expertise in RF systems has been a feature of the SLAC program for many years and SLAC has been the global ILC lead in the development of the HLRF power systems including the waveguide distribution system, a next generation state-of-the art solid-state modulator, and industrial klystron procurement.

Potential US Machine Involvement (2)

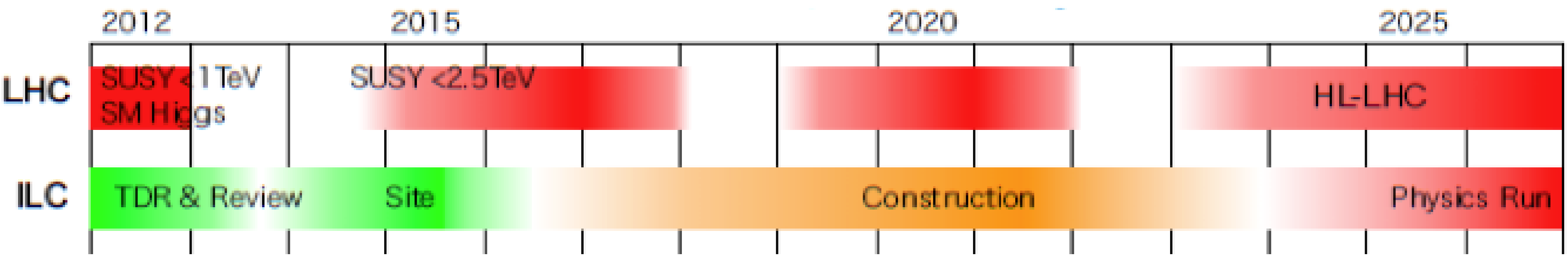
The R&D associated with the positron system has been performed by Argonne (undulators, beam dynamics) and Lawrence Livermore (target dynamics, positron capture pulsed systems). Both laboratory contributions are derived from specialized in-house expertise.

The ultra-compact magnet systems used in the ILC baseline final-focus elements adjacent to the interaction point, are based on direct wind technology which is only presently available at Brookhaven National Laboratory in the US.

A project of the scale and complexity of the ILC would be a major challenge for any single country. The US will need to play a role in the accelerator design as well as the final engineering design phase and hence part of the US contribution will be intellectual property. This would cover the positron source, damping rings, beam dynamics, transfer line, beam delivery system, and machine detector interface.

Timeline

Atsuto Suzuki @ the P5 meeting in Chicago



LCC working timeline

ILC Timeline

Proposed by LCC

- **2013 - 2016**
  - Negotiations among governments
  - Accelerator detailed design, R&Ds for cost-effective production, site study, CFS designs etc.
  - Prepare for the international lab.
- **2016 – 2018**
  - 'Green-sign' for the ILC construction to be given (in early 2016)
  - International agreement reached to go ahead with the ILC
  - Formation of the ILC lab.
  - Preparation for biddings etc.
- **2018**
  - Construction start (9 yrs)
- **2027**
  - Construction (500 GeV) complete, (and commissioning start) (250 GeV is slightly shorter)

Pre-project support

After the GDE phase the US has adopted a wait-and-see approach. "The GDE program was very successful but no signs of a LC project".

Since FY13 there has been no OHEP funding for the ILC beyond the LCC common fund (LCC Directorate support with Asia & Europe) and 2 FTE's & travel.

With movement in Japan we now need a support level to re-establish the US presence and prepare for possible subsequent events. We estimate this initially at $5M/yr ramping up to $10M in FY17 for the accelerators:

- Re-establish positron target R&D
- Small SRF R&D program (cavities & value engineering)
- 15 FTE's (positrons, damping rings, RTML, main linac, beam delivery, LCC & system leaders) for system and site specific design.