Update on LC activities in US

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LCWS 2018

Overview of US Activities in ILC

- The U.S. has been active in physics, detectors, and accelerator areas.

- A major focus for this year has been a re-evaluation by the ALCC of potential US contributions to ILC250.

- Active development of SCRF, US-Japan program.

- Very active engagement in refining/updating Physics studies.

- Both SiD and ILD have seen ongoing work on detector optimization (talks this afternoon).

Re-evaluation of potential US contributions to the ILC

Previous discussion/statement of US contributions was five years ago.

There have been ongoing projects (e.g. LCLS-II, XFEL) that have expanded and validated technologies.

If the ILC proceeds in Japan as hoped, for planning purposes we need to understand our capabilities and resources for contributions.

To define the timeline of US contributions we need to understand interactions with other projects.

Decision in late 2017 to establish an ALCC Task Force for re-evaluation of contributions.

Americas Linear Collider Committee

David Asner (PNNL), Jonathan Bagger (TRIUMF), Barry Barish (Caltech), Alain Bellerive (Carleton), Jim Brau (Oregon), Marcel Demarteau (ANL), Dima Denisov (FNAL), Paul Grannis (Stony Brook), Mike Harrison (BNL), JoAnne Hewett (SLAC), Steve Holmes (FNAL), Nigel Lockyer (FNAL), Joe Lykken (FNAL), David MacFarlane (SLAC), Lia Merminga (SLAC), Hugh Montgomery (Jefferson Lab, Chair), Hitoshi Murayama (UC Berkeley, LBNL, Kavli Tokyo), Marc Ross (SLAC), David Rubin (Cornell), Andy White (UT Arlington), Graham Wilson (Kansas)

Regular meetings held throughout this year

ALCC Action Plan Task Force

Hugh Montgomery (JLab - ALCC Chair)
Andy White (UTA - Task Force Chair)
Steve Holmes (Fermilab)
Marc Ross (SLAC)
Jim Brau (U. Oregon)
Andrew Hutton (JLab)
Dmitri Denisov (Fermilab)
Mike Harrison (BNL)
Michael Roney (U. Victoria)
Mark Palmer (BNL)
Marcel Demarteau (ANL)
Graham Wilson (U. Kansas)

Results of previous discussions: GDE/P5

US participation in an offshore ILC

Introduction

The possibility of US collaboration on a Japan hosted ILC is sufficiently real that identifying potential in-kind contributions in order to steer domestic preparations is prudent. The exact nature of any US contributions will of course be the product of multi-lateral negotiations but some informal assessment of the US capabilities can serve as a US starting point for these considerations.

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: unique (or world class) capabilities, strategic value to the domestic program, value to the project, and US industrial involvement, when assessing any particular contributions

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 ILC has adopted a production model similar to the XFEL (and the LHC). Based on a hub laboratory concept, this calls for industrial component and sub-assembly procurement with final assembly and testing in a laboratory environment. During the past decade Fermilab has invested significant resources in developing the processing, testing and fabrication capabilities required for the production of 1.3 GHz ILC cryomodules. We assess the cost and impact of using Fermilab as a cryomodule production hub although JLAB is also a possibility for cryomodule production.

LINEAR COLLIDER COLLABORATION

P5

Potential US Accelerator Collaboration with the ILC-in-Japan

Mike Harrison

LINEAR COLLIDER COLLABORATION

P5 - Closed

Potential US Contributions for the ILC-in-Japan

Accelerator & Detectors

Mike Harrison

Summary from GDE/P5

LINEAR COLLIDER COLLABORATION

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

P5@BNL Dec 2013
Mike Harrison

Preparation for Task Force meetings

Critical issues for developing proposed US contribution to ILC 250 in Japan

1) Review of P5 (2013) proposed contributions.

2) For each previously proposed lab contribution, how much is still relevant/feasible for the lab, and what new items could be added?

3) Infrastructure for proposed contribution - what exists, what would have to be created?

4) Availability (as a function of time) of personnel to work on a) planning, b) preconstruction detailed WBS, costs, c) construction, and d) possibility of hiring more staff?

5) Known obstacles to proposing contribution(s) to ILC e.g. conflict(s) with other major projects, lack of appropriate expertise etc.

6) Potential timeline for contribution(s) - with foreseen conflicts with other known projects/commitments

7) Timeline for decision on participation/proposal for making contributions - as a proposal from the lab.

AW – Fall 2017

Process

- Series of Task Force meetings

- Contributions from:

  Fermilab (Steve Holmes)
  SLAC (Marc Ross)
  Argonne (Marcel Demarteau)
  Jefferson Lab (Andrew Hutton)
  Brookhaven (Mark Palmer)

plus Detector (SiD) talk by Marty Breidenbach

NOTE: 1) These were informal discussions and results do not represent any commitment on the part of the Labs' managements.

2) The primary goal was to re-assess potential for US contributions to ILC250 in the event of a positive decision by Japan.

Timeline for Task Force discussions

2018 decision on ILC in Japan
2019 begin international negotiations
2020-23 develop full ILC TDR
2024-25 review TDR
2026 begin construction
2034 commission ILC

Fermilab

CM assembly/test: Scope is relevant and feasible. Based on LCLS-II excellent results (world record Q cryomodules) , most efficient model would probably be to establish U.S. cryomodule assembly at Fermilab (and JLab.)

Infrastructure: Both JLab and Fermilab capable of assembling and testing >1 CM/month. Fermilab has demonstrated 12 cavity vertical tests a week, plus has now two CM assembly lines, and two CM test caves, which decouples 1.3 GHz production line (currently LCLS-2) from PIP-2. So, a total production rate of 1/month could be done after LCLS-2 completion (2019) and of 1/week, as was desired in the past for ILC, could be achieved at Fermilab after 2025, when PIP-2 cryomodules are completed.

Personnel: Fermilab has developed world leading expertise in SRF cavities and cryomodules. Some of this personnel could be available for ILC pre-planning. LCLS-II will go on for another year and PIP-II is in development. As LCLS-2 winds down, more SRF technical experts will be available. There is enough workforce to support simultaneously PIP2 and LCLS-2, and later PIP-2 and ILC.

Obstacles/Timeline: ILC CM production may interfere with LCLS-2 HE, but timing may work fine (currently LCLS-2 HE ends in 2022). If PIP-2 proceeds to an HE upgrade to 2 GeV after 2025, then one more CM assembly line will be needed.

SLAC

Contributions: In the P5 plans, SLAC had proposed contributions in the areas of HLRF (klystron-modulators, klystrons, power distribution, and input power couplers).

SLAC could contribute 60-70 HLRF system units. The relevant personnel are still at SLAC and are interested in the project.

Infrastructure: SLAC is building a 60-cryomodule LINAC, for which there is a proposed CM test facility. This facility could form part (with Fermilab and JLab) of the US CM testing for ILC - but there would be no SRF component assembly at SLAC. The facility would belong to OBES and the ILC could be in competition for this resource at SLAC.

In addition to the HLRF and CM testing, SLAC could make intellectual contributions in the areas of beam delivery systems, and beam studies.

Argonne

Contributions: Argonne has developed a sliding contact cooling scheme for the positron source target design, built a prototype and successfully validated the concept and its design. ANL also worked on the beamline start-to-end simulations for the positron source.

ANL is also currently working with NIU, Hiroshima University and KEK, within the framework of the US-Japan Collaboration, on the development of a damping-ring-free electron injector for Future Linear Colliders.

All the items listed above are still relevant and are areas where Argonne can contribute. Possible areas for added contributions are the beamline and undulator designs.

Infrastructure: The positron target still exists and can easily be resurrected. The same holds true for the simulations. Undulator work - one of the leads of that effort is now part of the APS and this effort could be revived.

Personnel, funds: Almost all the efforts were funded out of the GARD program and that funding has dried up. For any serious effort, new funding would have to be made available.

Timeline: Positron source target project - ANL may be able to finish the in-vacuum demonstration and validation in a year or two if adequately funded. Start to end simulation work - some effort to restore the platform – then significant contributions to the cross-checking and validation of the beamline lattice and beam parameters.

Jefferson Lab

Contributions: A detailed proposal from Jefferson Lab was not included in the 2013 list. An addendum has been produced covering 50% of the US cryomodule production - the addendum is up to date.

Infrastructure: This exists but some would have to be augmented given the volume of work.

- Addition of two 4-post systems and assembly rails in the Test Lab
- Addition of one to two more cryomodule test facilities to support cryomodule acceptance test which exceeds testing of 30% of completed cryomodules
- Addition of one cryomodule test facility supports testing of up to 60% of cryomodules
- Addition of two cryomodule test facilities supports testing of 100% of all cryomodules
- Helium refrigeration plant with capacity to support additional test facility.

Personnel: person could be made available part time immediately for planning. Preconstruction preparations could happen as the LCLS II production is winding down. Construction could occur following the LCLS II project, which may also include the LCLS II energy upgrade. We have all of the technical lead staff in place.

Obstacles: LCLS II is clearly the principle potential conflict with ILC, but the timescales presently seem to be compatible. If ILC occurs later, need to train new technicians.

Brookhaven

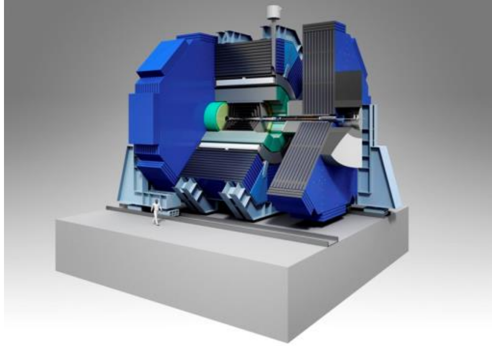
Contributions:

- IR magnets. BNL has unique direct wind capability and Brett Parker has prototypes. Brett Parker could also work on the IR design.

- Damping Rings. Mark Palmer could contribute to this area of accelerator design.

- Instrumentation. BNL has a very well known Instrumentation Division (now being lead by David Asner). They are presently engaged in effort for the Belle experiment.

Detector planning (SiD)



Marty Breidenbach gave the Task Force an updated version of his talk "Towards a Physical SiD".

SiD is still a concept, not a collaboration.

We will need technically a collaboration of ≥ 500 people.
They will have to develop an understanding of all the issues, optimize SiD, and buy into a design. This will take time.

- Optimize SiD - Can we lower costs and preserve performance?
- Follow new technologies.
- Prepare serious TDR with technical prototypes and serious cost estimate. 3 years:
  Assume R&D support resumes in 2019 then 2023 for TDR, review 2024
- Procurement, fabrication, and assembly: 6-7 years **2031**
- Begin Commissioning

This will require a restart of Detector R&D support starting in 2019.

Conclusions

- A survey of the US labs shows potential contributions to the ILC250 similar to those in the 2013 report.

- Additional support would be needed for planning, R&D, training technical staff, production ramp up etc.

- The present and planned tasks at the labs are mainly compatible with the anticipated ILC timeline.

- The development of a detector design, completion of a TDR, and construction is also compatible with the ILC timeline.

Going forward

Timeline:

2018 decision
2019 begin international negotiations
2020-23 develop full ILC TDR
2024-25 review TDR
2026 begin construction
2034 commission ILC

This timeline largely avoids over in spending profiles with major projects: DUNE/LBNE, PIP II, LHC.