Status of ILC Activities in America

International Workshop on Future Linear Colliders

Europe, March 15-18, 2021

A.J. Lankford
University of California, Irvine

America in the IDT

America in the International Development Team

IDT Executive Board

Andy Lankford (UCI) – Americas rep
Hitoshi Murayama (UCB/Tokyo) – WG3 chair

IDT WG1 – Pre-lab organization (includes EB)

Bruce Dunham (SLAC)
Reiner Krueken (TRIUMF)
Stuart Henderson (TJNAF)
Joe Lykken (FNAL)

IDT WG2 – Accelerator

SRF

Sergey Belomestnykh (FNAL)
Rongli Geng (ORNL)
Bob Laxdal (TRIUMF)
Matthias Liepe (Cornell)
Sam Posen (FNAL)
Bob Rimmer (TJNAF)
Marc Ross (SLAC)

DR/BDS/Dump

Tom Markiewicz (SLAC)
Brett Parker (BNL)
David Rubin (Cornell)
Nikolai Solyak (FNAL)
Glen White (SLAC)

Sources

Joe Grames (TJNAF)

IDT WG3 – Physics & Detector

Hitoshi Murayama (UCB/Tokyo) – WG3 chair

Steering Group

Jim Brau (Oregon)
Dmitri Denisov (BNL)
Patty McBride (FNAL)
Tim Nelson (SLAC)
Andy White (UT Arlington)

Speakers Bureau

Alain Bellerive (Carleton)

Detector & Technology R&D conveners

Petra Merkel (FNAL)
David Miller (Chicago)

Software & Computing conveners

Jan Strube (Oregon)

Physics Potential & Opportunities conveners

Michael Peskin (SLAC)

IDT-related organizational activities in America

A great deal of interest exists in U.S. and Canada to contribute to the Pre-lab.

- Contributions can be expected in many areas.

American WG1

John Byrd (ANL)
Dmitri Denisov (BNL)
Bruce Dunham (SLAC)
Stuart Henderson (TJNAF)
Reiner Krueken (TRIUMF)
Joe Lykken (FNAL)
Thomas Schenkel (LBNL)
Hugh Montgomery (ALCC)
Natalie Roe (LBNL)
Rik Yoshida (ANL)

- This group meets to give feedback and advice to representatives in IDT WG1.
- It also represents the labs in an advisory capacity to me.

American WG2 (names on previous slide)

- Americans in WG2 were active contributing to the Technical Preparation Document.
  - American participation in WG2 meetings went beyond WG2 members.
  - The next step is to make certain that TPD lists of candidate collaborating institutions are complete.
- The American members of IDT WG2 will lead the preparation of a collaborative proposal to DOE for funding for Pre-lab technical preparation activities for ILC.
  - a 'directed R&D program'

Technical Preparation Document Review

Camille Ginsberg (TJNAF)
Michael Harrison (BNL)
Tor Raubenheimer (SLAC), Chair

IDT-related accelerator activities in America

A great deal of interest exists in U.S. and Canada to contribute to the Pre-lab.

- Contributions can be expected in many areas.

Some further activities to date:

- A U.S. SRF subgroup has been active in developing plans for U.S. in-kind contributions to the Pre-lab program.
  - SRF is the largest, most intense and costly Pre-lab technical preparation and is to be shared roughly equally by the three regions.
  - This group has members from Cornell, Fermilab, SLAC, TJNAF, with ties to TRIUMF.
  - It has established discussion with DOE about the SRF supply chain in the U.S.
- Special meeting for US labs held with groups working on the polarized e^+ source.
  - U.S. labs interested in contributing include ANL, BNL, FNAL, LBNL, LLNL, SLAC.
  - Follow-up is expected, with probable formation of a sub working group.
- American lab attendance at the recent IDT crab cavity workshop included BNL, FNAL, LBNL, Old Dominion, SLAC, TJNAF, TRIUMF.
  - IDT WG2-SRF has formed a subgroup to rapidly further crab cavity development.
  - Canada has a particular interest in participating in development of SC crab cavities (as they are for HL-LHC).

Some future plans:

- A closer look at Damping Rings and Beam Delivery System for American labs.

Interactions with DOE

As American IDT representative, I interact with DOE Office of High Energy Physics (HEP).

- Jim Siegrist – DOE Office of Science Associate Director for High Energy Physics.
- Abid Patwa – HEP Energy Frontier Program Manager, and handles international agreements.
- Michael Procario - HEP Facilities Division Director, incl. projects & directed R&D programs
- LK Len – General Accelerator R&D Program Manager

HEP is supportive of Pre-lab program.

- I want to acknowledge briefing to HEP provided by IDT WG2 leader Shin Michizono.
- HEP is encouraging regarding funding.
  - Expect pre-lab funding to be in the form of a directed R&D program.
  - Requires time to ramp-up.
    - Budget request required by mid-2021 for US FY2023 funding.
    - FY2022 funding will be modest, and will favor R&D with benefit to other accelerator developments.
- HEP has expressed its interest in starting the Pre-lab in advance of the conclusion of Snowmass planning and before convening P5,

  in order that ILC is seen as a real possibility by the community and in P5 prioritization.

We have started a sequence of discussions to:

- Understand the possible of evolution of funding for Pre-lab and for ILC Lab.
  - Formulation of the US budget is a complex process with a long lead time.
- Prepare to brief the new administration.

View from the U.S. Government

U.S. Government Perspective on ILC

The U.S. government, including DOE, Department of State, and Office of Science & Technology Policy (OSTP), has been very supportive of the ILC in Japan.

Oct. 2019: DOE Under Secretary Paul Dabbar visited Japan and met with MEXT officials and Diet representatives in order to advance the ILC project in Japan, focusing first on the Pre-lab stage because in the U.S. it takes at least 2 years to formulate the budget.

Feb. 2020: A letter from DOE Secretary of Energy Dan Brouillette to Japan's Minister of State for Science & Technology Policy Naokazu Takemoto in the Cabinet Office stated:

> The Japanese model of investments in major research infrastructures, and your government's continued commitment to our shared values, gives the U.S. Department of Energy (DOE) confidence that the ILC can become a center of excellence in particle physics research in Japan and across the globe.
> DOE is therefore ready to begin engaging with Japan and other international partners to discuss topics of shared, collaborative resources towards the project, the proposed governance models for a potential ILC Laboratory, and the remaining research and development efforts that are needed to realize a future facility.
> Such discussions would naturally form the basis of the "pre-laboratory" phase of the ILC project.

DOE welcomes recent statements from MEXT Minister Hagiuda regarding international partners coming to the table. DOE would be eager to come to the table.

ILC-related SRF activities

ILC-related SRF Activities in America

Activities are carried out at BNL, Cornell, FNAL, JLab, ODU, SLAC, and TRIUMF. Most R&D is in collaboration with international partners: KEK, CEA, CERN, DESY, UKRI-STFC,…

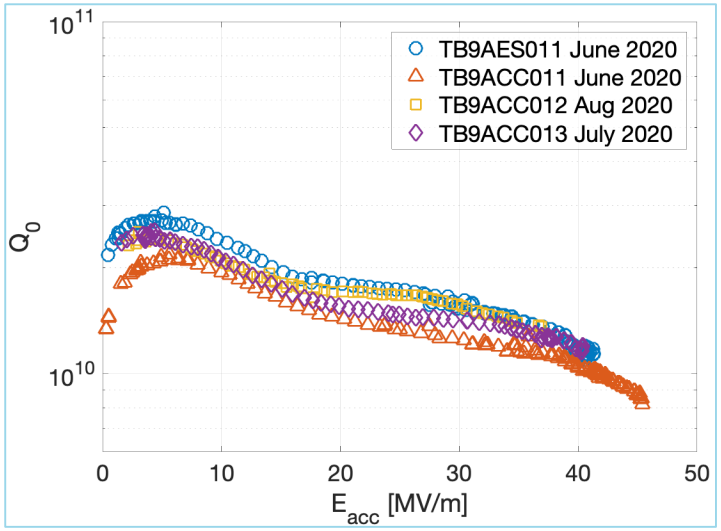
- **ILC cost reduction R&D program**:
  - Developing new surface treatments for Nb SRF cavities to improve quality factors and accelerating gradients – *will continue during ILC Pre-Lab*
  - Preparing demo of the new recipe in a High Gradient / high Q Cryo-Module (HGCM)
    - See S. Posen's talk during SRF session on Monday.
- Developing **cost-effective Nb material fabrication** with industry (medium-grain Nb discs directly sliced from an ingot) – *part of ILC Pre-Lab plan*
    - See T. Saeki's talk during SRF session on Wednesday.
- Developing **novel designs for crab cavities**,
  - *e.g.*, RFD and DQW for HL-LHC and EIC, elliptical cavities with waveguide HOM couplers and QMiR cavity for SPX experiments, deflecting cavity for ARIEL – Some of these designs could be considered for ILC crab cavities – *will continue during ILC Pre-Lab*
    - See P. McIntosh's talk during SRF session on Wednesday.
- Developing new, **more efficient SRF cavities**,
  - *e.g.*, Low Surface Field (LSF) and Traveling Wave (TW) structures – this R&D will continue with an aim for a *potential ILC upgrades*

Slide courtesy of S. Belomestnikh (FNAL)

ILC-related SRF Activities in America - HGCM

HGCM for demonstration of new SRF cavity processing recipe

- High gradient – high Q cryomodule collaboration work ongoing, **stretched goal E_{acc} > 40 MV/m with $Q > 10^{10}$**
  - **4 cavities qualified** for the cryomodule with E_{acc} > 40 MV/m.
  - Cavity treatment based on recent high gradient SRF R&D (**cold electropolishing, 2-step low temperature bake**)
  - Rebuild of first SRF module assembled at FNAL in ~2007 (disassembly has started – see image)
- Collaboration includes FNAL, JLab, Cornell, ANL, TRIUMF, KEK, DESY, Saclay, …
  - ILC cost reduction funds;
  - labs outside US contribute in-kind on different aspects, from magnetic shielding, to surface treatments, to cryomodule and components design



Fermilab Jefferson Lab DESY. cea Cornell University KEK-JAPAN Argonne National Laboratory TRIUMF

Slide courtesy of S. Posen & S. Belomestnikh (FNAL)

Physics & Detector activities

U.S. Physics and Detector Activities

Physics and detector studies in the U.S. have been reinvigorated by:

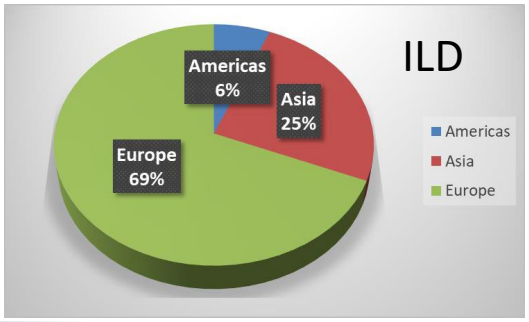
- Appointment of ILC IDT, and associated discussions of timeline for ILC experiments,
- Preparing for Snowmass Community Summer Study,
- Exploration of new experimental opportunities.

Funding for detector R&D and experiment development has been minimal in recent years, slowing past progress.

- Studies for Snowmass are supported through ongoing research program grants.
- Groups are anxious to resume intense detector R&D and expt. development, motivated to prepare for experiment construction in time for ILC operation.
- Hopefully we will see the funding situation change when the Pre-lab is launched and the timeline of the experimental program becomes clear.

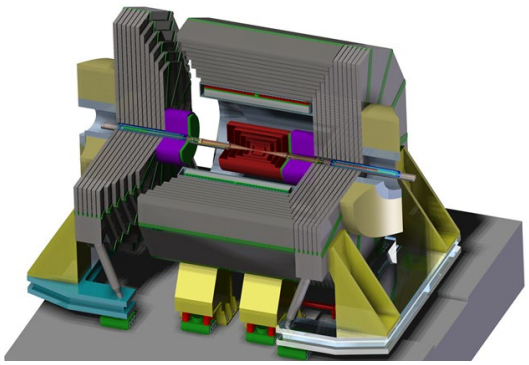
U.S. groups have long been active in both experiment concepts, SiD and ILD.

less so in ILD (see pie at right, and talk of Ties Behnke on Wed.) than in SiD (see next slide)



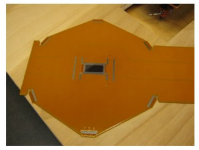
I look forward also to LCWS talks on new concepts, such as dark sector searches in fixed target and beam dump experiments.

U.S. Physics and Detector Activities - SiD

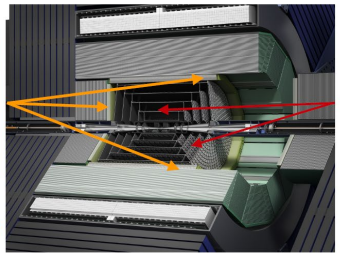


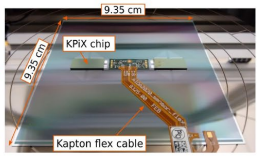
The SiD Detector Concept

A compact, cost-constrained design. Robust silicon vertex and tracking system.
Highly granular calorimeter system optimized for Particle Flow.
Design currently being re-assessed; considering potential technology updates.



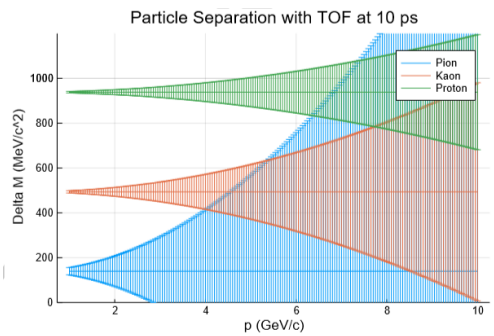
ECAL:
1200 m² sensor area





Tracker:
67 m² sensor area

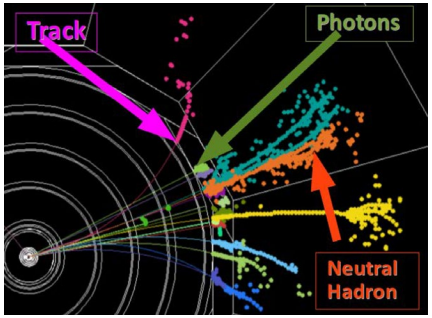
Update: add Time-of-Flight
Performance study for SiD
With 10 ps resolution.



Update: MAPS technology – VTX, TRK, ECal:
Integrated readout (no ASIC)
Less material; simplified construction; less cost.
Studies: pixel size, occupancies.
Target SiD-specific prototype design(s)

SiD is moving forward with R&D plans for the Pre-Lab. New people and new ideas are very welcome!

Update: add timing layers.
e.g. HCal to assist PFA in track-cluster association, identify slow shower components.



SiD-related talks at LCWS2021: SiD talk in Physics and Detector Plenary, M. Stanitzki, Wednesday 1440 CET
SiD updates in session N2; Overview of SiD Physics Analyses, C. Potter, session PD3. Si Beam Telescope, U. Kraemer, session PD5

Slide courtesy of A. White (UT Arlington)

Strategic planning

Strategic Planning – Canadian Subatomic Physics

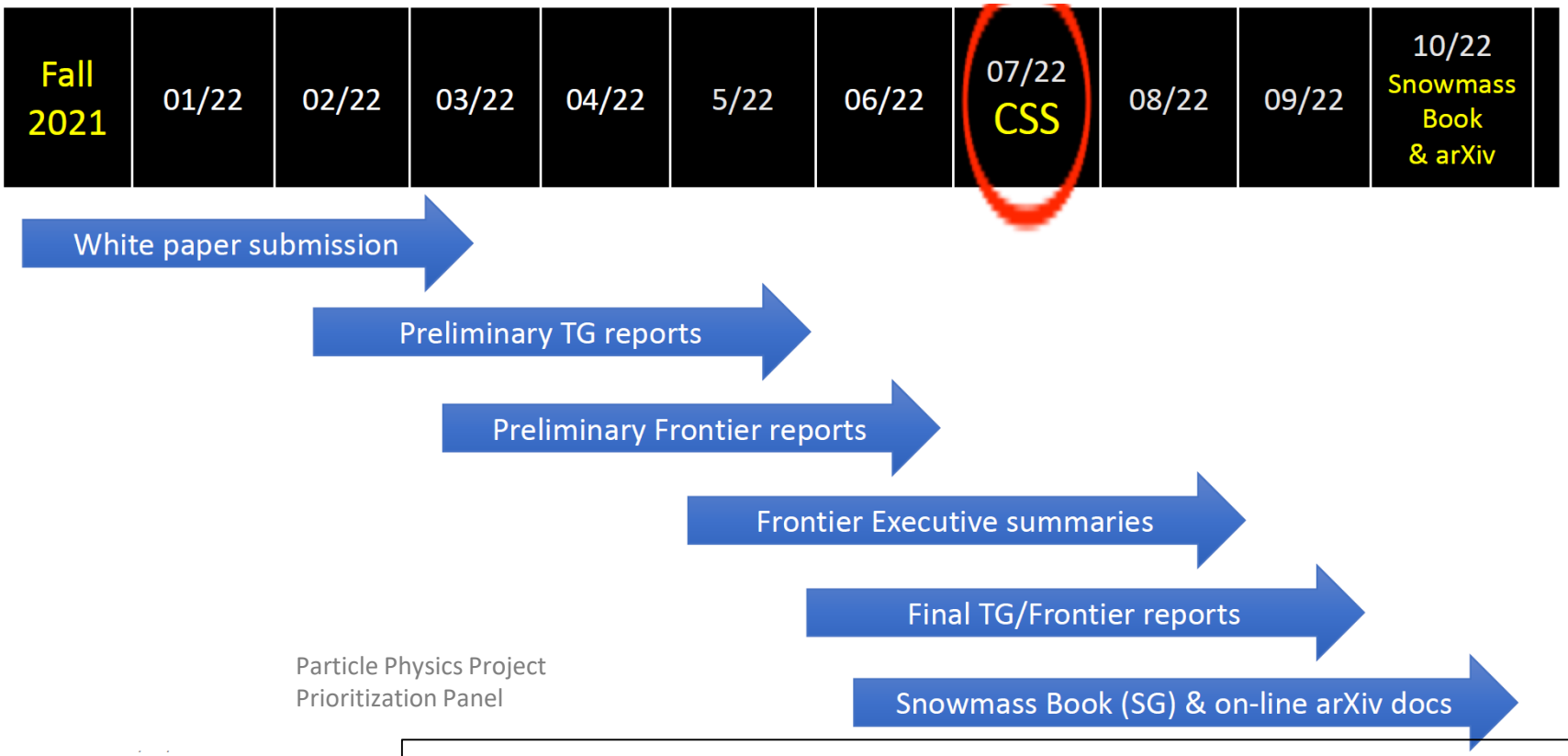
Formulating the Long Range Plan for 2022 – 2026.

Strategic Planning – U.S. Particle Physics

Formulating the Long Range Plan for ~ 2025 – 2035.

Snowmass Community Planning Process timeline

COVID caused a pause in Snowmass process,
with delay of 1 year for the Community Summer Study (CSS)



Particle Physics Project Prioritization Panel

P5 will convene after Snowmass and report in early 2024.

Snowmass Community Planning Process

Snowmass is vital to U.S. participation in the ILC:

- Participation in the ILC project depends upon another strong P5 recommendation, like the 2014 P5.
- The Snowmass community planning process forms the basis of P5 deliberations.

e^+e^- Higgs factory community should come out to support ILC at Snowmass.

- ILC is the one Higgs factory on the table now, and we do not want the opportunity to be lost.
- Snowmass is a global, grassroots process; we encourage everyone's participation.

The ILC group is preparing a ~200 page white paper for Snowmass,

- which will also be a reference document for P5.
- Welcome contributions to the writing of this report, and welcome everyone to join the author list as an endorser.
- See Michael Peskin's *Snowmass Update* presentation on Thursday.
- See also https://agenda.linearcollider.org/event/9135/.

P5 report expected early 2024, to inform Congressional FY2025 budget and the full FY2026 budget formulation process.

National Academies Elementary Particle Physics Decadal Study before P5 conclusion.

- Considered to be an independent assessment of the status and direction of field.

Closing

ILC Status in America - Summary

A great deal of interest exists in U.S. and Canada to contribute to the Pre-lab.

- U.S. and Canada are active in ILC IDT.
- Contributions to Pre-lab can be expected in many areas.

Close communication with DOE HEP, which is supportive of Pre-lab program.

The U.S. government has been very supportive of the ILC in Japan.

DOE welcomes recent statements from MEXT Minister Hagiuda regarding international partners coming to the table. DOE would be eager to come to the table.

In other recent activities,

- **Accelerator R&D efforts focus on SRF.**
- **U.S. physics & detector studies have been re-invigorated.** Groups are anxious to resume intense detector R&D and experiment concept development in near future.

Strategic planning processes are underway in both U.S. and Canada.

- In both nations these processes are vital to future ILC involvement.
- **Contribute to these processes in order to help make the ILC a reality.**