Americas Regional Program

G. Dugan

ILC/GDE and Cornell University

ILC MAC Review

Apr. 7, 2006

Outline

- Organization of the Americas Regional Team
  - MoU process; FY06 budgets;
- FY06 Program
  - FY06 ILC R&D program highlights, including university R&D program
  - FY06 program concerns
- Outlook for FY07 and beyond
- Conclusion

ILC Program Execution

In the Americas region, the ILC program (the RDR effort, and supporting ILC R&D), is executed by the Americas Regional Team.

ILC-Americas Regional Team Leaders

ANL-Kwang-Je Kim

BNL-Mike Harrison

Fermilab-Bob Kephart, Shekar Mishra, Sergei Nagaitsev

Cornell LEPP- Hasan Padamsee, Mark Palmer

Jefferson Lab -Swapan Chattopadahay, Warren Funk

LLNL -Jeff Gronberg

LBNL -Mike Zisman, Christine Celata

SLAC -Tor Raubenheimer, Nan Phinney, Tom Himel

TRIUMF - Shane Koscielniak

Universities- Project Leaders

Organization of the ILC-Americas Program

- The work is broken down into a series of technically-based work packages.
- GDE and each DoE lab sign MoU's detailing the co-operative arrangement for the execution of work packages at each lab.
- Yearly scope of work is spelled out in Addenda to the MoU, which detail the work packages.
- For university R&D work, each university project is a work package.
- Labs report financial status at the work package level quarterly, and technical status semi-annually.
- About 100 work packages for FY06 are organized into a WBS. (NOT the project WBS for the RDR).
- The list of work packages, and associated resources, as well as the MOU Addenda, are posted on the ILC-Americas web site:
  https://wiki.lepp.cornell.edu/ilc/bin/view/Public/Americas/WebHome

FY06 budgets: Breakdown by Machine Area

MACHINE AREA	FTE	DOE FY06 M&S Direct	DOE FY06 Total Total	NSF FY06
Program direction and administration	9.50	$766	$3,006	$326
Management	4.10	$100	$761	$0
Global systems	4.47	$519	$1,158	$0
Electron sources	3.35	$100	$658	$0
Positron sources	10.32	$159	$1,988	$0
Damping rings	9.63	$509	$2,135	$0
Bunch compressor	1.30	$0	$214	$0
Main Linacs: Optics, beam dynamics, instrumentation	5.74	$75	$988	$0
Main Linacs: RF systems	16.84	$1,451	$4,410	$0
Main Linacs: Cavities and Cryomodules	16.90	$3,961	$7,380	$242
Beam delivery system	14.38	$376	$2,796	$0
Conventional facilities	2.69	$519	$1,039	$0
Technical Systems	0.00	$590	$870	$0
Reserve			$2,437	
	99.23	**$9,126**	**$29,841**	**$568**

FY06 budgets: Breakdown by Laboratory

Lab / Univ	FTE	DOE FY06 M&S Direct	DOE FY06 Total Total	NSF FY06
SLAC	56.18	$2,683	$12,300	$0
FNAL	30.00	$6,046	$12,600	$0
ANL	3.40	$27	$300	$0
Jlab	1.00	$136	$400	$0
Jlab (FNAL MOU)		$600	$600	$0
LLNL	2.25	$180	$1,000	$0
LLNL (SLAC MOU)	0.42	$50	$200	$0
LBNL	2.48	$30	$500	$0
BNL	3.50	$25	$600	$0
Cornell (FNAL MOU)		$165	$165	$0
UNIV	0.00	$0	$280	$568
DOE/GDE			$1,860	$0
sum	**99.23**	**$9,126**	**$29,841**	**$568**

Most labs are also putting additional funds into ILC R&D. For example, Fermilab is devoting an additional ~$12 M to developing SCRF infrastructure.

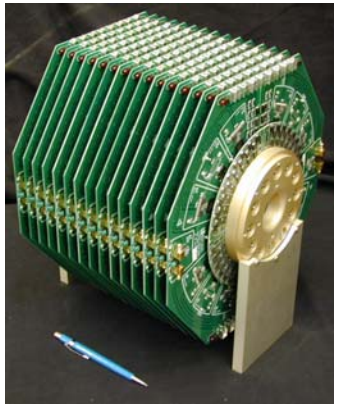
ILC-Americas University FY05 R&D Program

- SCRF materials and surface preparation: Wisconsin ($64K), Northwestern($40K), Old Dominion ($58K)
- RF power sources: Yale ($60K), MIT($30K)
- Polarized electron source: Wisconsin ($35K)
- Polarized positron source: Tennessee ($40K), Princeton
- Damping rings: Illinois ($17K), Cornell ($75K, $46K) **[NSF]**
- Instrumentation, diagnostics: Berkeley ($35K), Cornell ($24K) **[NSF]**
- Mover systems: Colorado State ($49K) **[NSF]**
- Radiation hard electronics: UC Davis ($38K), Ohio State ($75K)
- Ground motion: Northwestern ($28K)
- Linac beam dynamics design-Cornell ($21K)
- High-gradient SCRF R&D- Cornell ($140K) **[NSF]**

Global Systems

- System availability studies (SLAC)
- Design of high availability hardware (SLAC, LLNL)
  - Kickers, Power supplies, diagnostics, and control system

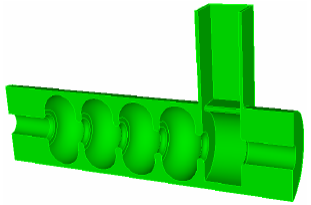
Fast (redundant) kicker for DR

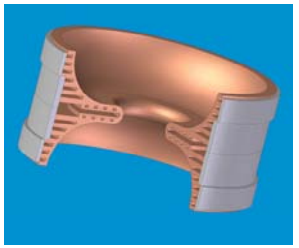


- General control system design (ANL, Fermilab, SLAC)

Sources

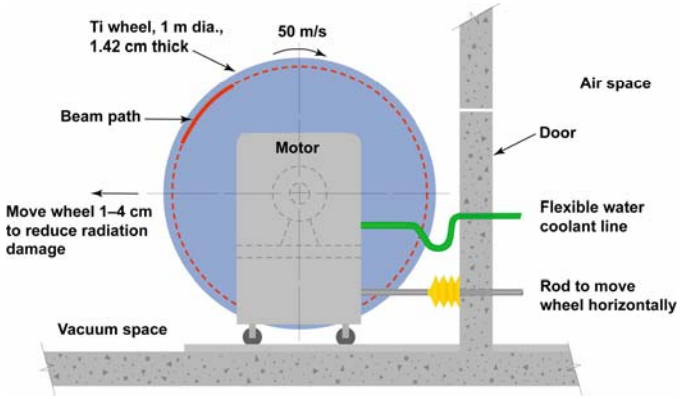
- Laser and cathode for polarized electron source (SLAC)
- NC structures: design and test (SLAC)





Positron capture structures

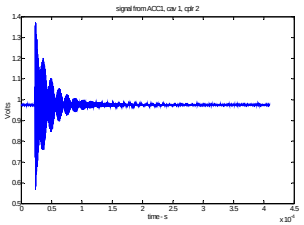
- Undulator design, E166 (SLAC, Cornell)
- Positron Source simulations (ANL)
  - A comprehensive start-to-end simulation of conventional, polarized, and keep-alive sources.
- Positron target design (LLNL)
  - Detailed engineering
  - Target simulations
    - Energy deposition
    - radiation damage, activation



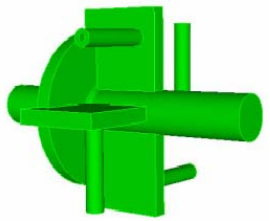
Damping rings

- Damping ring component optimization: wigglers, fast kickers; studies of the use of CESR as an ILC positron damping ring test facility (in 2008) (Cornell)
- Damping Ring Design and Optimization (ANL)
  - Lattice design and optimization; particle tracking for single-bunch instabilities with 3-D wakefield; studies of ion instability in the APS ring; design of a hybrid wiggler satisfying the field quality tolerance
- SEY studies in PEP-II (SLAC)
- ATF damping ring experiments (SLAC, LBNL, Cornell)
- Lattice designs for damping rings and injection/extraction lines; characterization of some collective effects, including space-charge, IBS and microwave instability; physics design of stripline kickers for single-bunch extraction at KEK-ATF (LBNL)

- RTML design (SLAC, Cornell)
- Main linac optics design (SLAC, Fermilab)
- Low emittance transport simulations and BBA design (SLAC, Fermilab, Cornell)
- Wakefield calculations (SLAC)
- Linac beamline Instrumentation (SLAC)



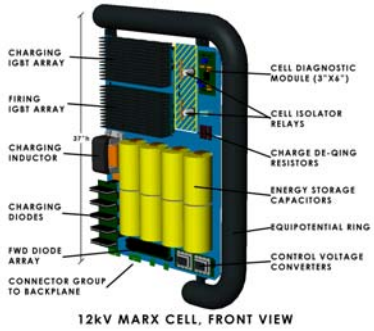
TTF HOM Signal 800 monitors installed



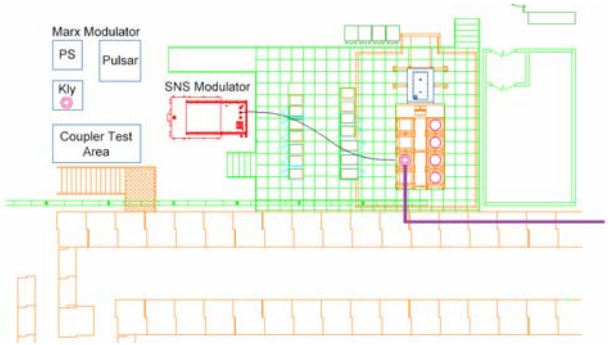
RF BPM for linac

Main Linac RF sources

- Linac rf sources (SLAC, LLNL)
  Marx generator modulator



  - SLAC End Station B (RF Test Fac.)
    - Develop 5 MW station in FY06, and 10 MW station later
      - Test rf system components
      - Reuses extensive infrastructure



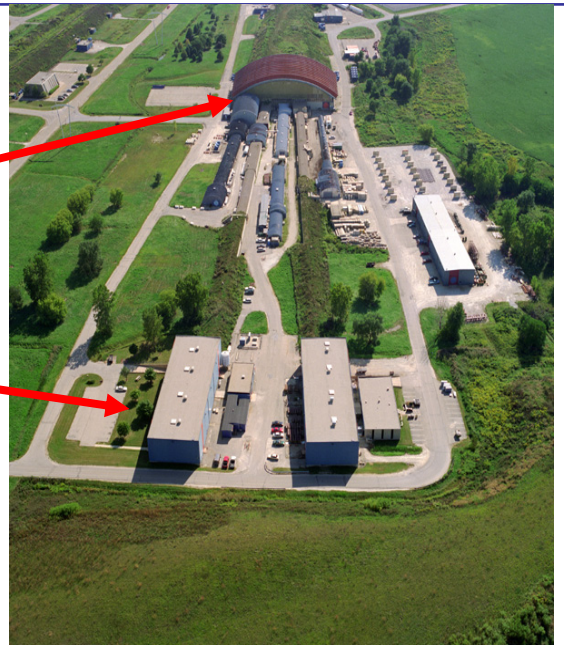
  - Coupler Test Stand (LLNL)
    - Evaluation and analysis of RF coupler designs
  - Linac SC quad and BPM (SLAC)
    - Studies of magnetic center stability with excitation

ILC Cavities and test facilities

Joint ANL/FNAL BCP/EP Facility

Meson Detector Building (MDB)

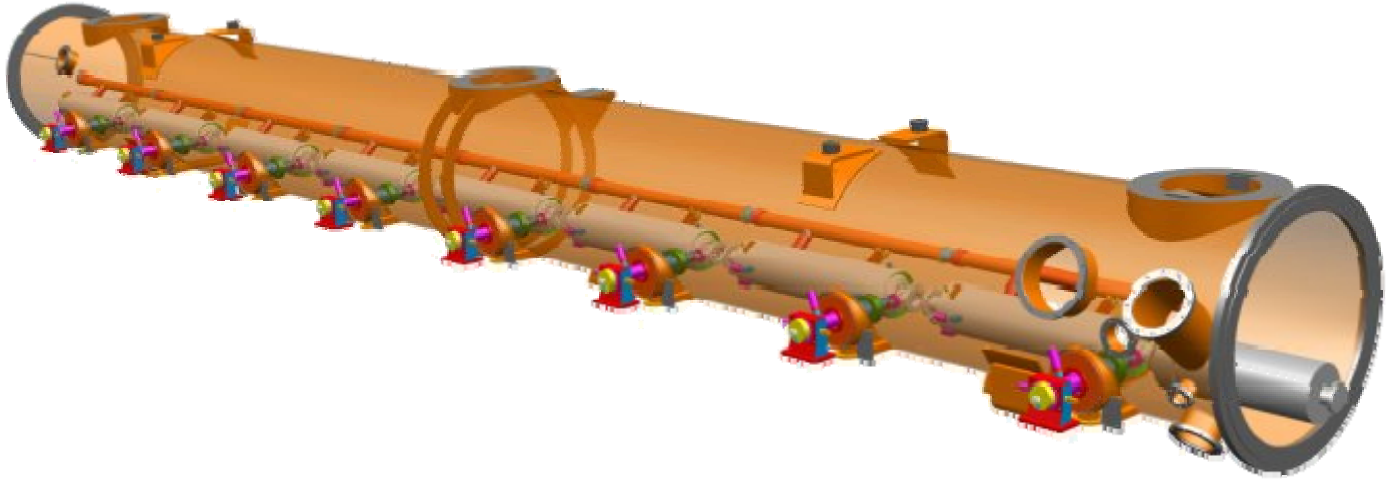
TD MP9 Cryomodule Assembly Facility (CAF)



- Industrial fabrication of cavities (12 cavities in FY06) (FNAL)
- BCP and vertical testing (FNAL, Cornell)
- EP process development and vertical testing (FNAL, Jlab).
- Joint BCP/EP facility being developed at ANL (late 06)
- Horizontal test facility @ FNAL (ILCTA-MDB) (complete Fall 06)
- Vertical test facility under development @ FNAL (ILCTA-IB1) (complete 07)

Cryomodule Design

- Industrial fabrication and cost reduction of the ILC cryomodule are both crucial issues for a realistic ILC cost estimate
- In FY05 Fermilab started on converting drawings of the DESY/INFN design of the ILC cryomodule (Type-III+) to US standards for U.S. vendor fabrication and for cost reduction.
- IN FY06, as part of a co-ordinated global effort, design has started for an improved ILC cryomodule (Type-IV).



Cryomodule string test: ILCTA-NML at Fermilab

Building a dedicated ILC cryomodule string test facility in the New Muon Lab

- Building is cleaned out except for removal of CCM (in progress)
- Started to install cryogenic system-complete in FY07
- Move FNPL Photo-injector to provide electron beam (FY07)
- Upgraded FNPL will provide beam tests of ILC cryomodules (FY08 and 09)

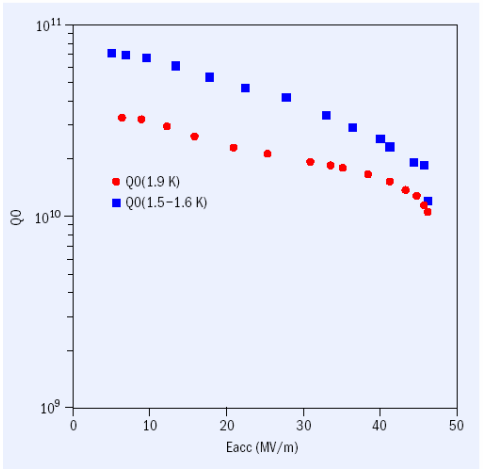
High gradient cavity R&D

Jlab: Fabricate, process and test cavities from large-grain/single-crystal material)

- Objectives (not a complete list):
  - Several single cell and at least one multi-cell cavity made from large grain/single crystal niobium and BCP processed.
  - Test cavity for superconducting rf joint investigations;
  - Two cavities suitable to be combined into a superstructure

Cornell LEPP: ILC high-gradient SCRF

- Re-entrant Cavity Shape:
  - 47 MV/m at Cornell…Later 52 MV/m at KEK
  - 9-cell re-entrant cavity ordered from AES



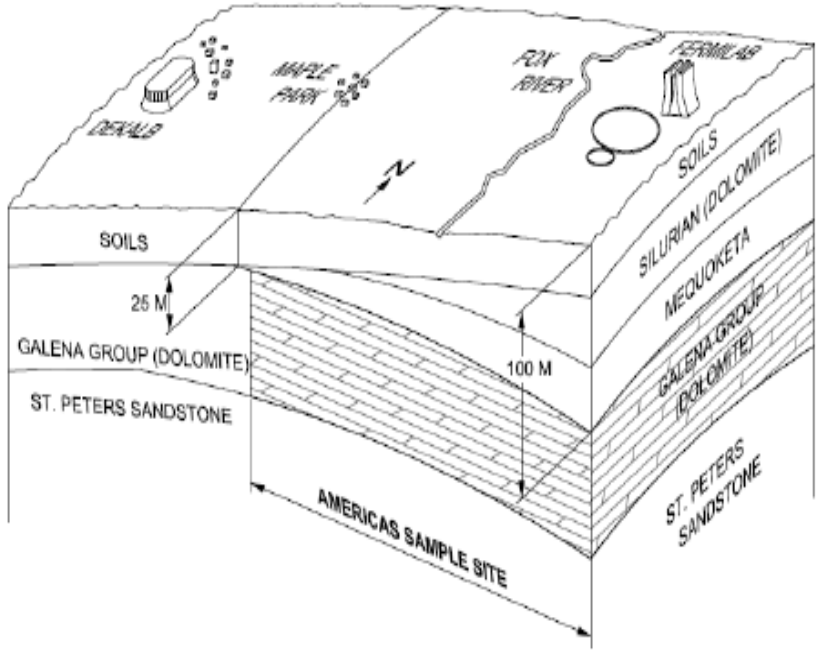
Beam Delivery System

- Beam delivery system design (SLAC)
- ATF-2 (SLAC)
  - Construction of magnets, PS, and instrumentation
- ESA MDI Test Facility (SLAC)
- NanoBPM for ATF2 (LLNL)
- ILC Final Focus Magnet Development (BNL)
  - Continue to support the baseline design efforts, and the development of the Conceptual Design/Cost Estimate for the Beam Delivery System
  - Fabricate and test a short proof of principle shielded final-focus-like quadrupole coil
  - Fabricate and test a short proof of principle sextupole/octupole corrector-like coil

ILC Civil Design for the RDR

- Design to “sample sites” from each region
  - Americas – near Fermilab
  - Japan
  - Europe – CERN & DESY
- Americas Site - in Illinois– location may vary from the Fermilab site west to near DeKalb
- Design efforts ongoing at Fermilab and SLAC

Americas Sample Plan / Section



Potential TRIUMF Accelerator R&D Resources for ILC

The specific nature of Canadian involvement is under development. Some potential collaboration areas have been identified, along with relevant LHC experience:

- The design of kicker magnets and the construction of associated pulse-forming networks and fast switches using power semiconductors
- Precision room temperature magnet systems
- Beam instrumentation and readout systems
- Contributions to beam dynamics & lattice calculations for damping rings.
- Remote handling design/consulting of target stations possible applicability to conventional positron source
- Peripheral aspects of superconducting r.f., such as cryogenic coolant distribution system, design/consulting, small quantity e-beam welding of niobium
- Vibration control systems and alignment of components for final focus system; also interest in abort kickers

FY07 outlook

- PB doubles ILC program budget to $60M (This includes ILC detector R&D at labs and universities)
- However, the requested (“technically limited”) program (~$98M) exceeds the available funding. A process of prioritization will be required.
- This process should look to GDE for guidance on priorities. Advice will be sought from GDE R&D Board for general ILC R&D efforts, and from Linear Collider Steering Group for the Americas (LCSGA) for region-specific Americas bid-to-host related activities.
- First steps: document FY07 lab program requests (April 24); Regional team meeting to discuss FY07 requests and future plans (May 3-4, SLAC)

FY07 ILC program request

- TDR engineering efforts (~50 FTE)
- Cavity and cryomodule work
- RF system development
- Sources, Damping rings, beam delivery
- Global systems
- Americas region bid to host

Cavities, cryomodules and test infrastructure

- Fabricate (in industry) and process (at labs) 12 more ILC high-gradient cavities; continue R&D on large-grain and high-gradient cavities.
- Continue R&D on EP processing, field emission/dark current issues, thin film systems; develop EP facility at ANL.
- Horizontally test 10 cavities at Fermilab.
- Build first US-built cryomodule and receive parts for 2nd cryomodule (to be built in FY08).
- Complete design of Type IV (ILC-style) cryomodule.
- Complete vertical test facility, and second horizontal test facility, at Fermilab (IB1).
- Install cryogenic systems support for cryomodule tests in Fermilab's ILCTA-NML.
- Upgrade and move Fermilab photoinjector to ILCTA-NML.
- Purchase 10 MW klystron and another bouncer modulator for ILCTA-NML at Fermilab

Linac RF systems

- Continue development of Marx modulator, and evaluation of DTI and SNS modulators: downselect modulator choice by end of FY07.
- Purchase two 10 MW klystrons from CPI and Toshiba. Contract with CPI to develop a high-efficiency 5 MW klystron. Fabricate two sheet-beam klystron prototypes, following SLAC design (split funding in FY07 and FY08). Goal is klystron choice by end of FY08.
- Investigate cost reduction options for RF distribution system and couplers.
- Continue development of LLRF systems

Conclusions

- In the Americas region, the Americas Regional Team is playing a major role in the development of the ILC RDR and cost estimate.
- A vigorous R&D program, in support of the GDE goals, is underway in FY06 at national labs and universities throughout the Americas region.
- Next year, as the project enters the TDR phase, a significant increase in resources will allow development of the TDR, expansion of the R&D program, and the start of efforts to develop the Americas region bid to host the ILC.
- The requested resources for an FY07 technically limited program exceed those expected to be available.
- Challenges remain in completion of the RDR and cost estimate this year, in cavity processing and klystron R&D, and in effective co-ordination of the regional R&D programs.