Americas

ILC-Americas Regional Team Activities

G. Dugan

ILC/GDE and Cornell University

HEPAP Meeting
July 7, 2006

Americas

Outline

- GDE Mission and Leadership from the Americas
- Organization of the Americas Regional Team
- FY06 ILC R&D program highlights
- Outlook for FY07 and beyond
- Conclusion

International Linear Collider

The Global Design Effort

Mission

Reference Design Report (RDR) and cost estimate

• Produce a design for the ILC that includes a detailed design concept, performance assessments, reliable international costing, an industrialization plan, and a siting analysis, as well as detector concepts and scope.

• Coordinate worldwide prioritized proposal driven R & D efforts (to demonstrate and improve the performance, reduce the costs, attain the required reliability, etc.)

Global R&D program

GDE Leadership

Americas

Color coding:
Fermilab
SLAC
Jlab
Universities

Executive Committee
Barry Barish-Director
Gerald Dugan – Americas Regional Director
Brian Foster – Europe Regional Director
Tor Raubenheimer – Americas Accelerator Design Leader
Mitsuaki Nozaki – Asia Regional Director
Nicholas Walker – Europe Accelerator Design Leader
Kaoru Yokoya – Asia Accelerator Design Leader

Change Control Board
Nobu Toge (Chair)
Grahame Blair
Warren Funk
Kiyoshi Kubo
Masao Kuriki
Tom Markiewicz
Shekhar Mishra
Carlo Pagani
Daniel Schulte

R&D Board
Bill Willis (Chair)
Chris Damerell
Eckhard Elsen
Terry Garvey
Hotoshi Hayano
Toshiyasu Higo
Tom Himel
Lutz Lilje
Hasan Padamsee
Marc Ross
Andy Wolski

Design and Cost Board
Peter H. Garbincius (Chair)
Wilhelm Bialowons
Jean-Pierre Delahaye
Atsushi Enomoto
Robert Kephart
Ewan Paterson (Sys. Integration)
Nan Phinney (RDR Editor)
Tetsuo Shidara
Nobuhiro Terunuma

Americas

GDE RDR Leaders

GDE RDR Matrix

Lab color coding:
Fermilab
SLAC
LBNL
ANL
Jlab

Area Systems	e- source	e+ source	Damping Rings	RTML	Main Linac	BDS
		Kuriki	Gao	ES Kim	Hayano	Yamamoto
	Logachev		Guiducci		Lilje	Angal-Kalinin
	Brachmann	Sheppard	Wolski	Tenenbaum	Adolphsen	Seryi
			Zisman		Solyak	
Technical Systems						
Vacuum systems	Suetsugu	Michelato	Noonan			
Magnet systems	Sugahara	Bomdarchuk	Tompkins			
Cryomodule	Ohuchi	Pagani	Carter			
Cavity Package	Saito	Proch	Mammoser			
RF Power	Fukuda		Larsen			
Instrumentation	Urakawa	Burrows	Ross			
Dumps and Collimators	Ban	Densham	Markiewicz			
Accelerator Physics	Kubo	Schulte				
Global Systems						
Commissioning, Operations & Reliability	Teranuma	Elsen	Himel			
Control System	Michizono	Simrock	Carwardine			
Cryogenics	Hosoyama	Tavian	Peterson			
CF&S	Enomoto	Baldy	Kuchler			
Installation	Shidara	Bialwons	Asiri			

Americas

ILC Program Execution

In the Americas region, the ILC program is executed by the Americas Regional Team, under the co-ordination of the GDE.

ILC-Americas Regional Team Lab 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

Americas

Organization of the ILC-Americas Program

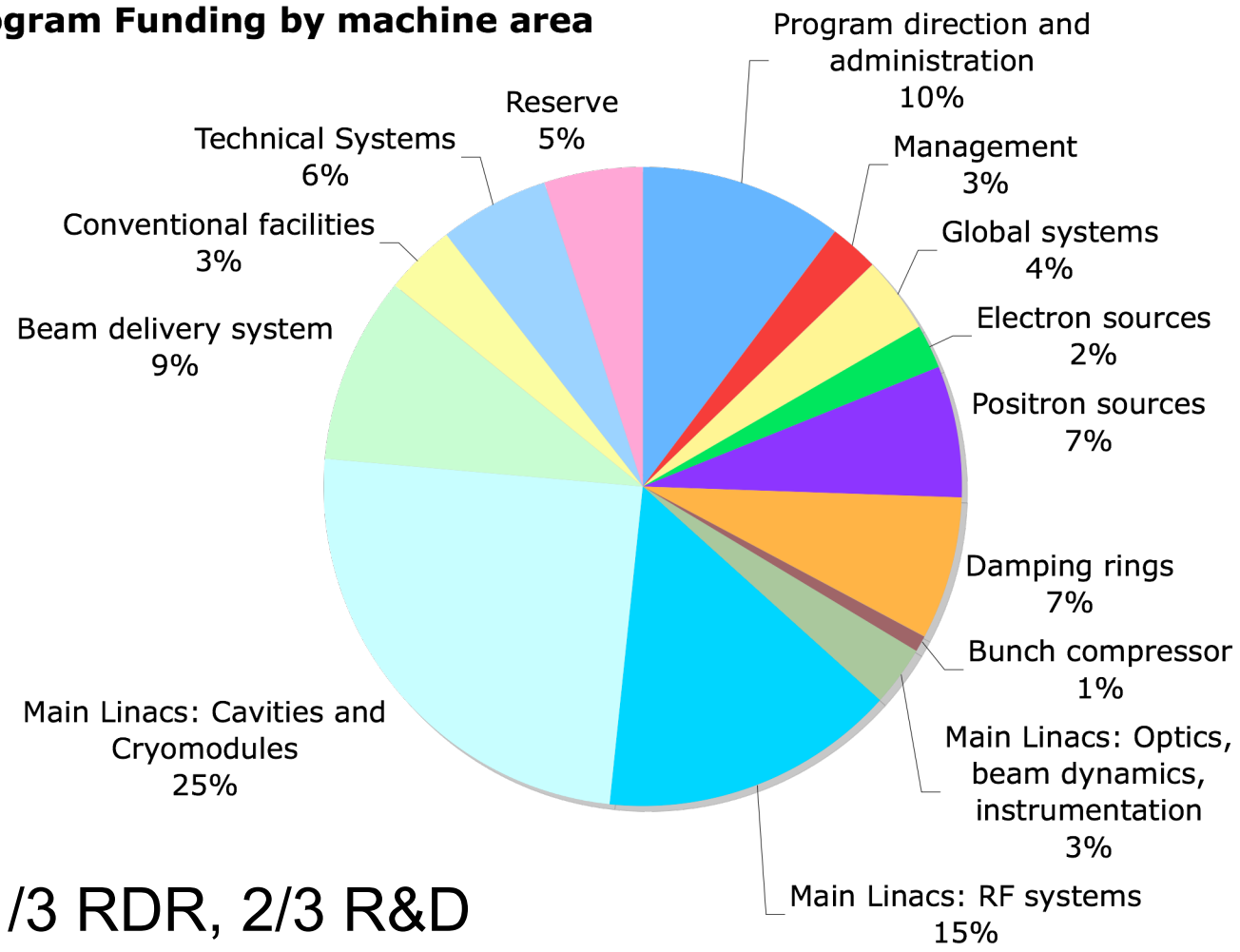
- The work is broken down into a series of technically-based work packages, documented in MoU's detailing the co-operative arrangement for the execution of work packages at each lab.
- Labs report financial status at the work package level quarterly, and technical status semi-annually.
- About 100 work packages for FY06 are organized into a WBS.
- The list of lab work packages, and associated resources, as well as the MoU's, and the details of the university program, are posted on the ILC-Americas web site:

  https://wiki.lepp.cornell.edu/ilc/bin/view/Public/Americas/WebHome
- The program was reviewed by DOE/NSF on April 4-6, 2006, at Fermilab. The agenda and talks can be found at

  http://ilcagenda.cern.ch/conferenceDisplay.py?confId=159

FY06 budgets: Breakdown by Machine Area

FY06 ILC Program Funding by machine area



~1/3 RDR, 2/3 R&D

Americas

FY06 budgets: Breakdown by Laboratory

Lab/Univ	*FTE*	*DOE FY06 M&S Direct*	*DOE FY06 Total*	*NSF FY06*
SLAC	56.18	$2,683	$12,300	$0
FNAL	30.00	$6,396	$13,011	$0
ANL	3.40	$27	$300	$0
Jlab	1.00	$136	$522	$0
Jlab (FNAL MOU)		$600	$600	$0
LLNL	2.25	$180	$1,000	$0
LLNL (SLAC M	0.42	$50	$200	$0
LBNL	3.11	$42	$682	$0
BNL	3.50	$25	$600	$0
Cornell (FNAL MOU)		$165	$165	$0
UNIV	0.00	$0	$280	$568
DOE/NSF/GDE			$1,146	$200
sum	**99.86**	**$9,488**	**$29,841**	**$768**

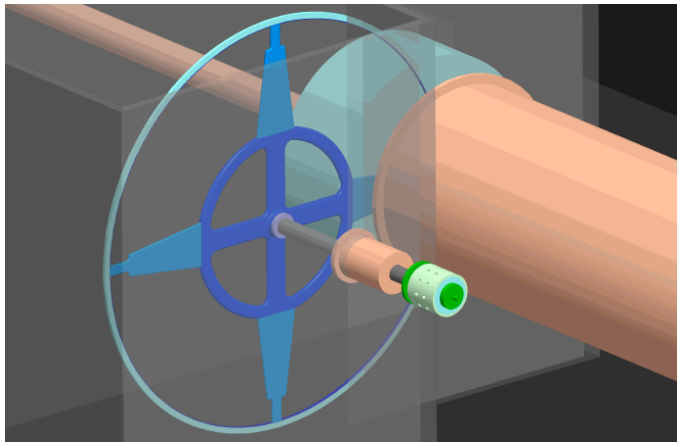
Most labs are also putting additional funds into ILC R&D. For example, Fermilab is devoting an additional ~$12 M to developing SCRF infrastructure. The DOE/NSF/GDE piece includes the university accelerator R&D program (~$700K from DOE and ~$200K from NSF.)

Electron and positron sources

SLAC, ANL, LLNL, Cornell

- Electron Source
  - photocathodes, laser, gun (SLAC)

- Positron Source-
  - Overall design, targets, radiation, E166 expt (SLAC)
  - End-to-end Monte Carlo modeling of undulator-based scheme, and design of pulsed normal conducting AMD (ANL)
  - Undulator design (Cornell)
  - Positron target design (LLNL)

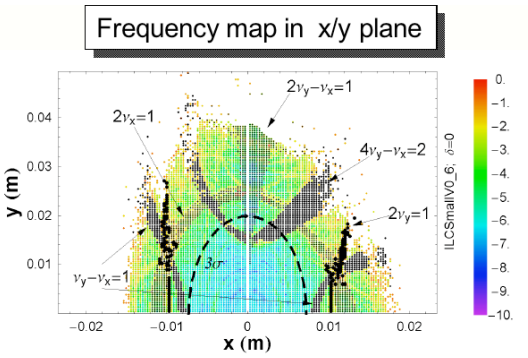


Americas

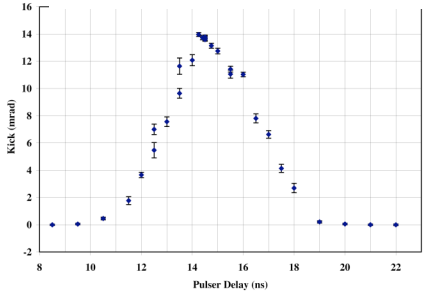
Damping rings

ANL, LBNL, Cornell, SLAC, LLNL, FNAL

- Produced a refined baseline lattice, parallelize ELEGANT, develop multi-objective evolutionary optimization codes (ANL)
- Inj./extr. line design and characterization, beam dynamics, wiggler vacuum system, quadrupole, and sextupole design/costing, ATF inj./extr. kicker design, and beam dynamics, fast ion instability tests at ALS (LBNL)
- Studies of wigglers: electromagnetic design, impact on ring dynamic aperture, costing; study of the use of CESR as an ILC positron damping ring test facility (Cornell);
- Studies of fast kickers (SLAC, Cornell, LLNL, FNAL)
- Electron cloud measurement & mitigation: SEY measurements, sample test chamber in PEP2, grooved chamber tests, clearing electrode tests (SLAC)



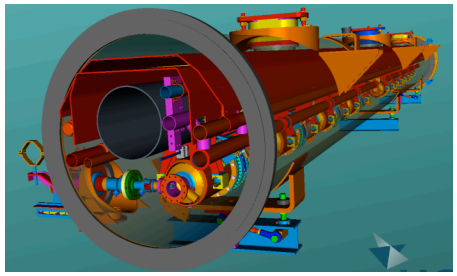
FID pulser test at A0



Main Linac, Siting

FNAL, SLAC

- DOE has expressed interest in hosting the ILC at a site near FNAL.
- Fermilab has focused its R&D efforts on the ILC Main Linacs.
- The main thrust of the Fermilab ILC Accelerator R&D is to establish US technical capabilities in Superconducting Radio Frequency (SCRF) Cavity and Cryomodule technology.
- Fermilab is developing extensive infrastructure with these goals:
  - To determine cavity processing parameters for a reproducible cavity gradient of 35 MV/m
  - To design, produce and test an ILC-specific cryomodule.
  - To test one ILC rf unit at ILC beam parameters, high gradient, and full pulse rep rate
- FNAL is collaborating with DESY, INFN, KEK, CERN, JLAB, SLAC, and U.S. Industry on the design of the next generation ILC cryomodule (Type IV)
- Civil and Site Development activities (FNAL, SLAC):
  - Civil engineering of machine enclosures
  - Study U.S. sites on or near the Fermilab site
  - Estimate costs for conventional facilities



Fermilab ILC Infrastructure

FNAL

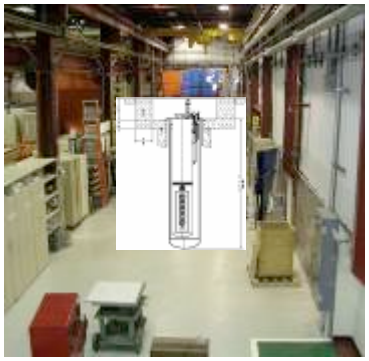
Americas

Eddy Current Scanner

RF Measurement and Tuning

BCP Facility at ANL

Cavity Vertical Test Stand



Horizontal Test Stand

Cavity String Assembly Clean Room Class 10/100

Cryomodule Assembly @ MP9

LLRF

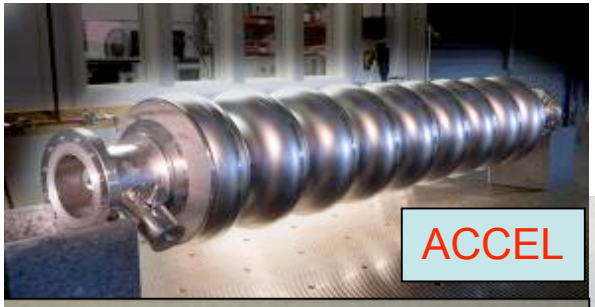
1.3 GHz Cavity at 2 K

Fermilab Photo-injector

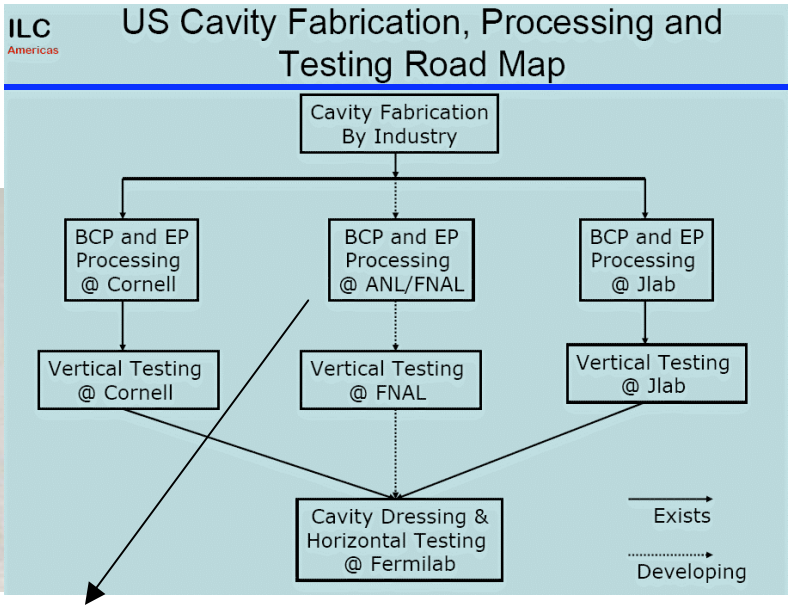
ILCTA @ Fermilab

Main Linac Cavity R&D FNAL, ANL

- To speed progress on the ILC cavities gradient goal, a multi-lab collaboration has been formed which
  - Maximizes the utilization of existing U.S. SRF infrastructure
  - Develops Fermilab expertise and infrastructure in parallel



Fermilab cavity procurement: 60 Cavities (by FY07)



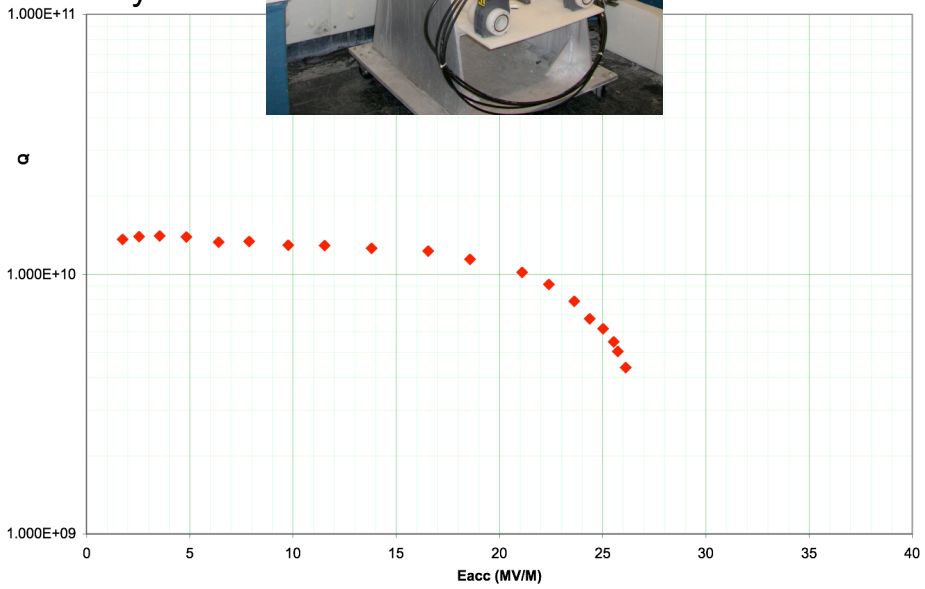
Electro-polishing of SCRF cavities (ANL/FNAL MOU)- In FY06: Develop a system specification for EP of 9-cell cavities at the ANL-FNAL Joint Chemical Processing Facility

Main Linac Cavity R&D

Cornell

Americas

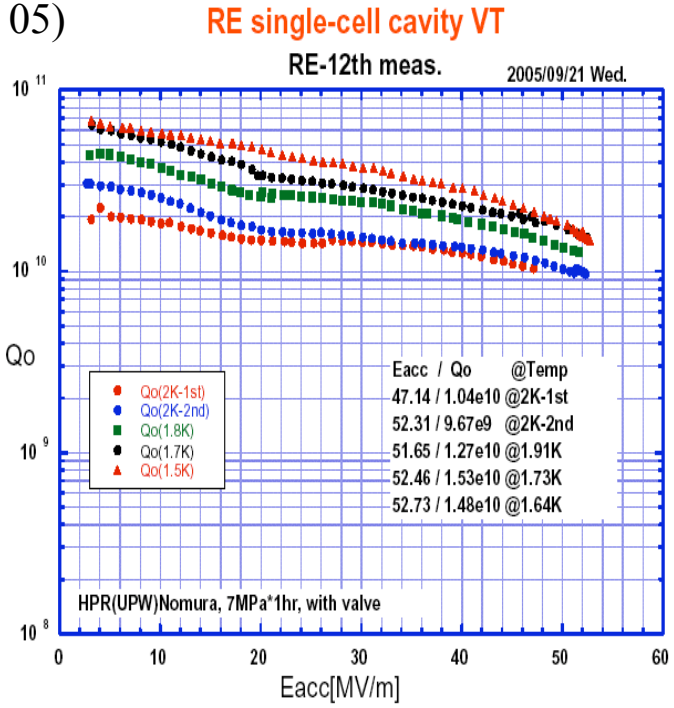
9-cell ILC cavities testing (BCP)-1st US-processed TESLA-style cavity



Q vs. E curve at 2.05 K

Single-cell High gradient R&D

- Re-entrant shape Single Cell Cavity reached 47 MV/m in May 05
- 2nd Re-entrant Cavity (built at Cornell) treated and tested at KEK, reached 50+ MV/m at KEK (Sept 05)



Main Linac Cavity R&D

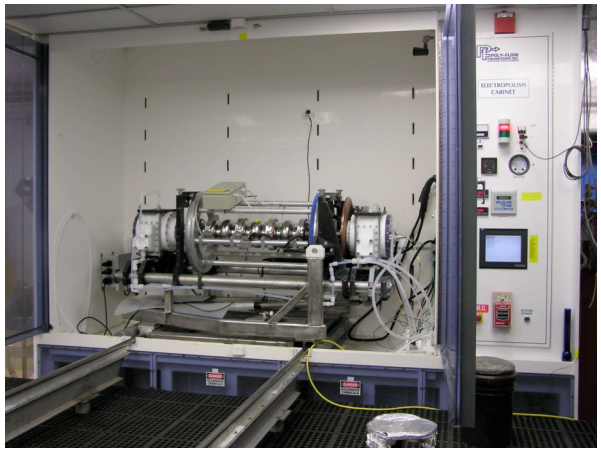
JLab

Electropolishing:

• 9-cell TESLA cavities being tested and electropolished at Jlab.

• EP cabinet adapted for 9-cells.

• Process development underway, with offline experiments to understand process variables



Jlab electropolish cabinet adapted for 9-cell cavities

Large grain material R&D:

Single -cell tests from 3 vendors

- Remarkably consistent performance 30-36 MV/m

7-cell LL cavity tested

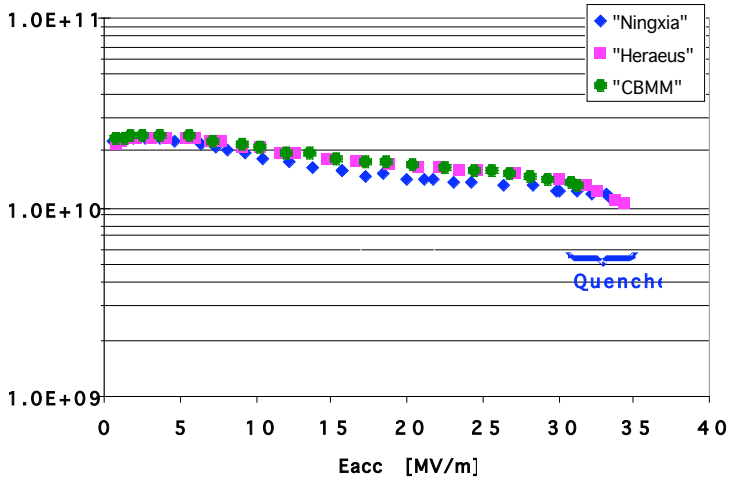
- ~20 MV/m, limited by available RF power

9-cell cavities in fabrication

- 1 fine grain, 2 large grain cavities underway.

Superconducting joint tests underway

- NbTi flanges, Nb gasket



Single Cell – Different Vendors

Main Linac RF Power Sources

SLAC, LLNL

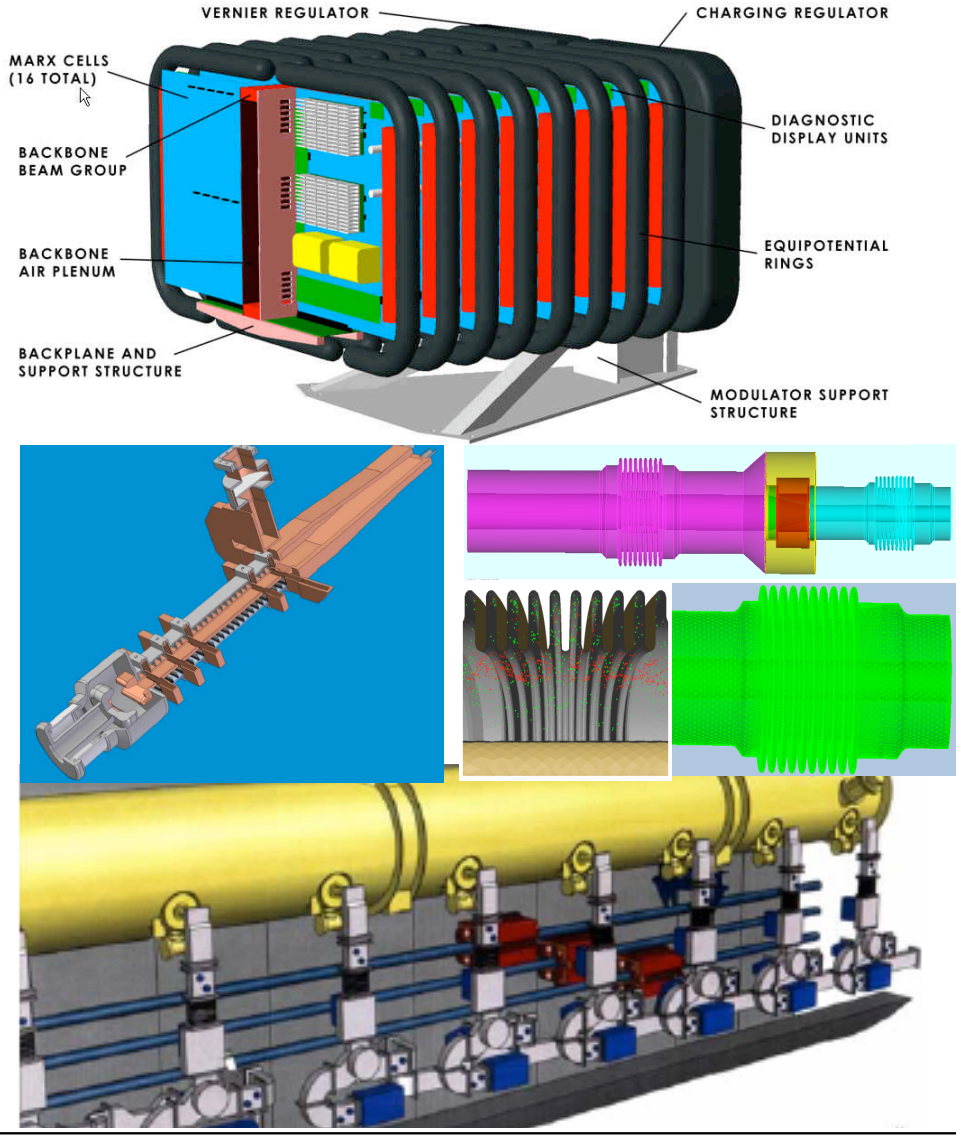
SLAC leads world-wide RF Power Source effort for ILC

In FY06:

5 MW L-Band *test stand* running in ESB with SNS spare modulator

R&D on alternate technologies to reduce cost, improve reliability:

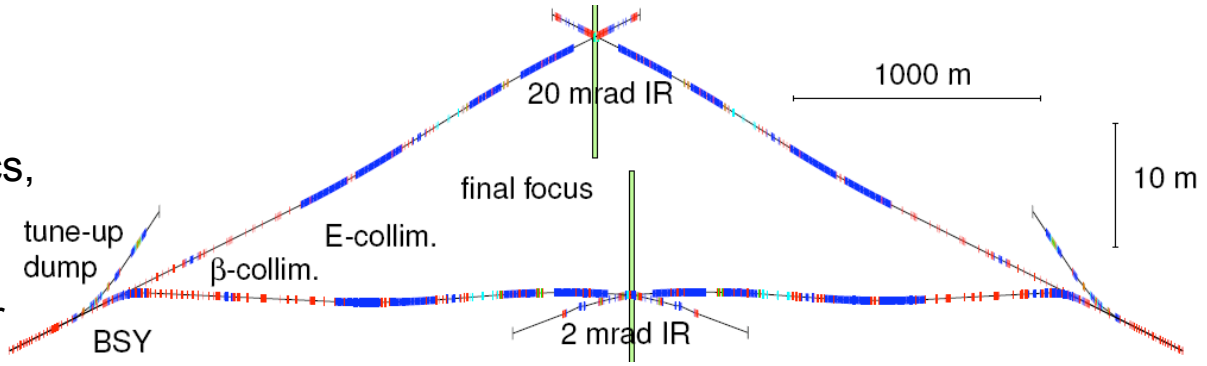
- Marx Modulator prototype
- Sheet-beam klystron design
- More compact RF distribution
- Coupler test stand
- Collaboration with LLNL on Marx design and coupler R&D

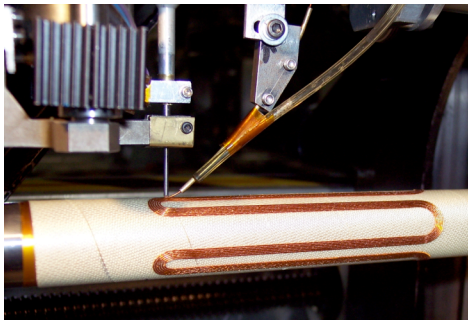


Beam Delivery System, ESA and ATF2 SLAC, BNL, FNAL

Americas

- **BDS** – RDR design & documentation; R&D on collimation, FF optics, diagnostics, magnets, backgrounds;
- **ESA MDI/IR test facility** for energy spectrometers, collimator wakefields, etc.
- **ATF2 test facility @KEK International collaboration:** optics design, modular power supplies, BPM electronics, movers





Final Focus SC Magnet (BNL)

• Use active magnetically shielded QD0 for 14 mr crossing angle. Concept successfully tested by winding active shield coil for QT, the short magnetic prototype.

• Winding of short final focus test octupole, OC0, is complete.Will wind and test sextupole, SD0, on top of OC0 (study relative centering of co-wound coils).

Americas

Availability, Operations, Controls, and commissioning

SLAC, ANL, FNAL, LLNL

SLAC has unique experience with operating the 1st linear collider, the SLC

Availability simulation & analysis, comparison of machine options

Commissioning strategy – tune-up dumps, separate PPS zones

Machine Protection System – requirements, design, logic

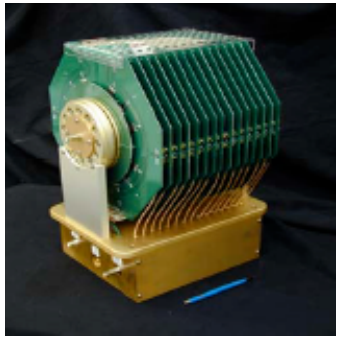
Machine tuning simulations – feedback, beam-based alignment

Control system design and development-

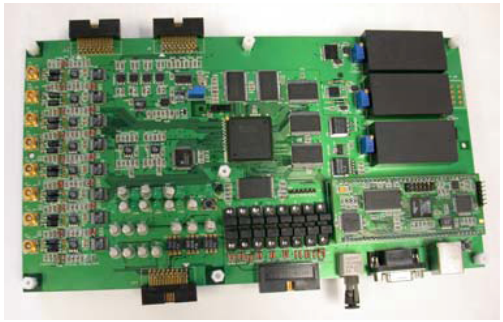
Leading the worldwide effort and making significant technical contributions to the control system design and costing for the RDR (ANL, SLAC, FNAL)

High Availability hardware R&D

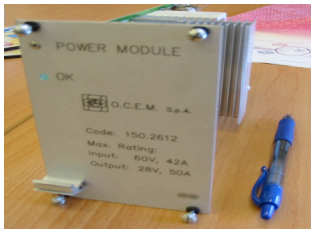
HA Kicker pulser

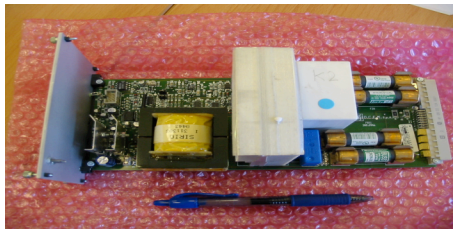


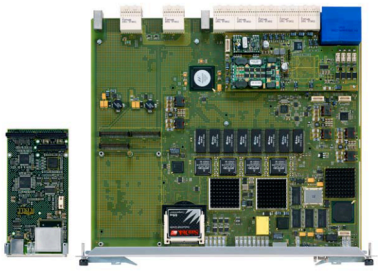
Diagnostics

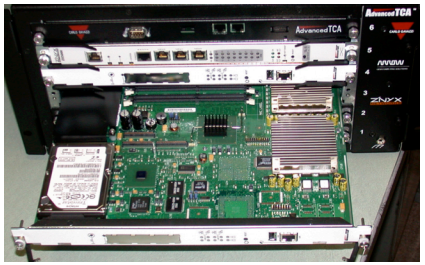


HA power supplies for ATF2









HA magnet analysis & design

ATCA standard for controls

Americas

FY07 ILC program in the Americas

- Design and engineering efforts in support of the GDE Technical Design Report (TDR).
- Cavity and cryomodule work
- RF system development
- Sources, Damping rings, beam delivery
- Global systems
- Technical R&D in support of the US regional interest (proposal to be developed by Osaki panel, formed under the auspices of the LCSGA)

FY07 program: lab requests

MACHINE AREA	DoE FY06 Budget			DoE FY07 Lab Requests		
	FTE	*M&S (Direct)*	Total	*FTE*	*M&S (Direct)*	Total
Program direction and administration	9.5	$766	$2,909	12.4	$1,234	$4,241
Management	4.1	$100	$761	9.6	$310	$2,017
Global systems	4.5	$519	$1,158	25.0	$1,787	$6,645
Electron sources	3.4	$100	$658	11.2	$1,435	$4,102
Positron sources	10.3	$159	$1,988	11.4	$541	$3,252
Damping rings	9.6	$509	$2,135	15.3	$617	$4,239
Bunch compressor	1.3	$0	$214	1.2	$100	$337
Main Linacs: Optics, BD, instrum.	5.7	$75	$988	8.1	$145	$1,568
Main Linacs: RF systems	16.8	$1,451	$4,410	19.3	$4,870	$9,544
Main Linacs: Cavities and Cryomodules	16.9	$3,961	$7,380	36.5	$6,340	$13,383
Beam delivery system	14.4	$376	$2,796	18.6	$875	$4,430
Conventional facilities	2.7	$519	$1,039	1.6	$485	$845
Technical Systems	0.6	$952	$1,664	32.9	$1,514	$7,503
Reserve			$1,740			$3,700
Regional Interest (includes all infrastructure)				107.05	$18,297	$39,251
TOTAL	99.9	$9,488	$29,841	309.9	$38,551	$105,057

Cavities, cryomodules and infrastructure

FNAL, ANL, Jlab, Cornell

- Fabricate (in industry) 24, 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

Main Linac RF systems

SLAC, LLNL, FNAL

- 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

Americas

FY07 planning

- PB ~doubles ILC program budget to $60M (This includes ILC detector R&D at labs and universities)
- However, the requested ("technically limited") program (~$105 M) exceeds the available funding. A process of prioritization will be required.
- This process started with a Regional Team meeting to discuss FY07 requests and future plans (May 3-4, SLAC).
- The FY07 requests have been reviewed by the GDE R&D Board, and evaluated in terms of relevance, degree of duplication, and urgency, for the global ILC R&D program.

Americas

FY07 planning

- The GDE is developing globally-coordinated plans for cavity R&D needed to validate the project gradient goals (S0); for demonstration of the operational gradient in a cryomodule (S1); and for test of strings of cryomodules (S2). Plans for the TDR effort will also be developed.
- The FY07 ILC program in the US will be aligned with the GDE priorities, and structured to conform to the GDE R&D S0, S1, S2 and TDR plans, to the extent possible on the required time scale.
- For technical R&D proposed in support of the US regional interest, input will also come from the Ozaki panel.
- We expect that recommendations to the DOE on the FY07 program can be provided by the end of July.

Americas

Planning for FY08 and beyond

- In FY08 and beyond, the ILC will require a robust R&D program, and a major effort to create a Technical Design Report (TDR).
- Technical R&D in the regional interest will also need to be ramped up.
- To develop a multi-year R&D plan for the Americas region, a similar process will be undertaken as is being done for FY07, involving consultation with the GDE and alignment of the ILC-Americas program with the global R&D plans, to maximize the benefit to be gained from global coordination.
- Regional R&D requirements will be assessed by the Ozaki panel and also incorporated into the program.

Americas

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 technical R&D in support of the US regional interest.
- The requested resources for an FY07 technically limited program exceed those expected to be available. A process of prioritization, in close coordination with the GDE, and including input related to regional interests, is being carried out.
- This process will serve as a model for developing a multi-year R&D plan.