Report from Frascati GDE meeting

P. McBride

Dec 13, 2005

CD Accelerator Activity Meeting

TTC Meeting (Dec 5-7)

https://ilcsupport.desy.de/cdsagenda/fullAgenda.php?ida=a0561

- Tesla Technology Collaboration Meeting
  - Focus on SCRF technology
    - Cavity production and testing
    - Communications among laboratories
  - An international collaboration
    - 49 institutions
    - DESY: focus is TTF and R&D for the XFEL
    - ILC SCRF R&D
    - Coordinate effort at global test facilities(with beam):
      - (DESY(TTF), KEK(STF), FNAL(ILCTA))
- Issue is how to balance between
  - Project driven R&D
  - More global R&D

Fermilab and the TTC

- Helen Edwards is head of the Technical Board
  - Helen would like to strengthen the collaboration with DESY on TTF
- Communication on projects at FNAL
  - SMTF (ILCTA), cavity production and testing
  - Collaboration on LLRF - workshop this week, DESY people may be here in February
  - TTF is a good place to test instrumentation

GDE meeting (Dec 7-9)

http://www.linearcollider.org/cms/?pid=1000185

- Focus on GDE organization
- Approval of BCD (Strawman for ILC Baseline design)
- Preparations for RDR (reference design report)
  - Costs, issues of ILC parameters
    - # of tunnels, cavity gradient, # of interaction regions, technology choices (risk vs cost), damping rings, # of bunches

Global Design Effort

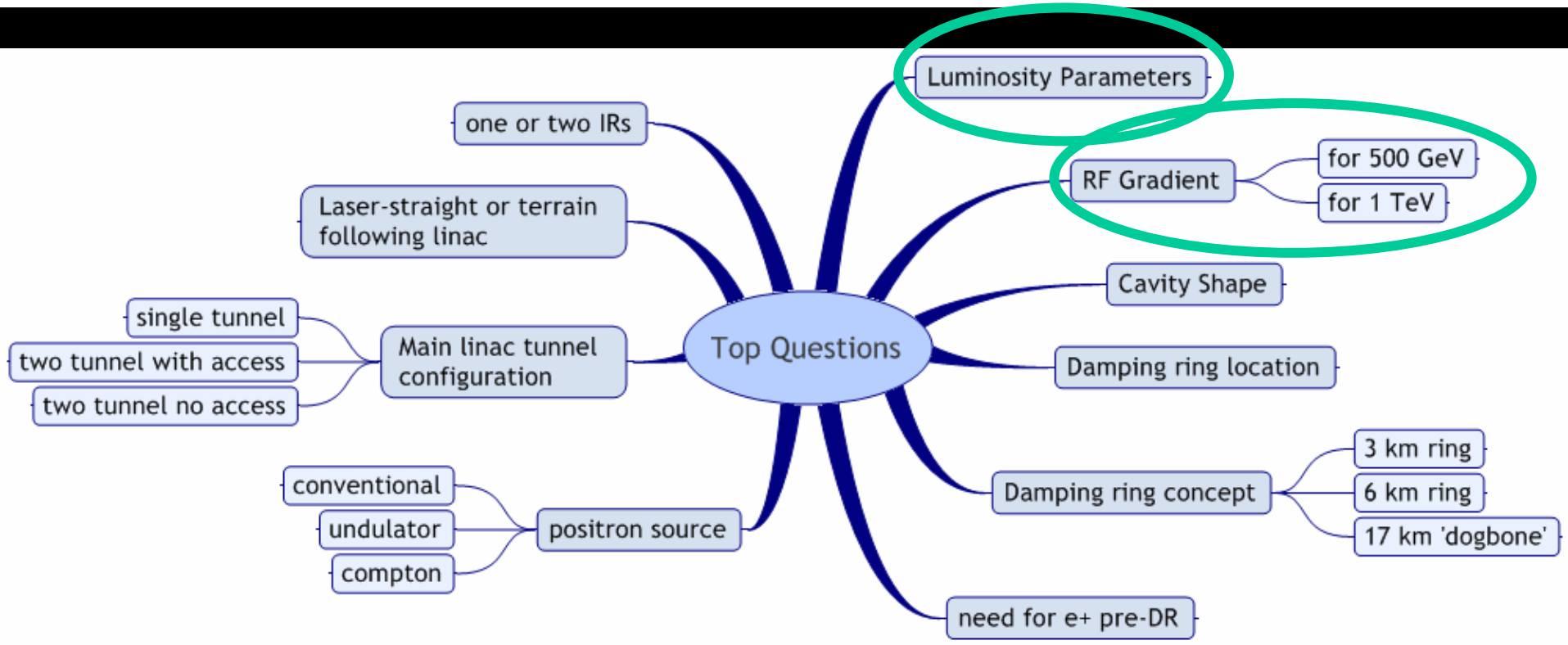
- The Mission of the GDE
  - Produce a design for the ILC that includes a detailed design concept, performance assessments, reliable international costing, an industrialization plan , siting analysis, as well as detector concepts and scope.
  - Coordinate worldwide prioritized proposal driven R & D efforts (to demonstrate and improve the performance, reduce the costs, attain the required reliability, etc.)

Baseline Configuration Document

- Our ‘Deliverable’ by the end of 2005

- A structured electronic document
  - Documentation (reports, drawings etc)
  - Technical specs.
  - Parameter tables
  - …
- A ‘printable / readable’ summary document (~100 pages) (ready in early 2006)
- BDC Document
  - http://www.linearcollider.org/wiki/doku.php?id=bcd:bcd_home

The Key Decisions



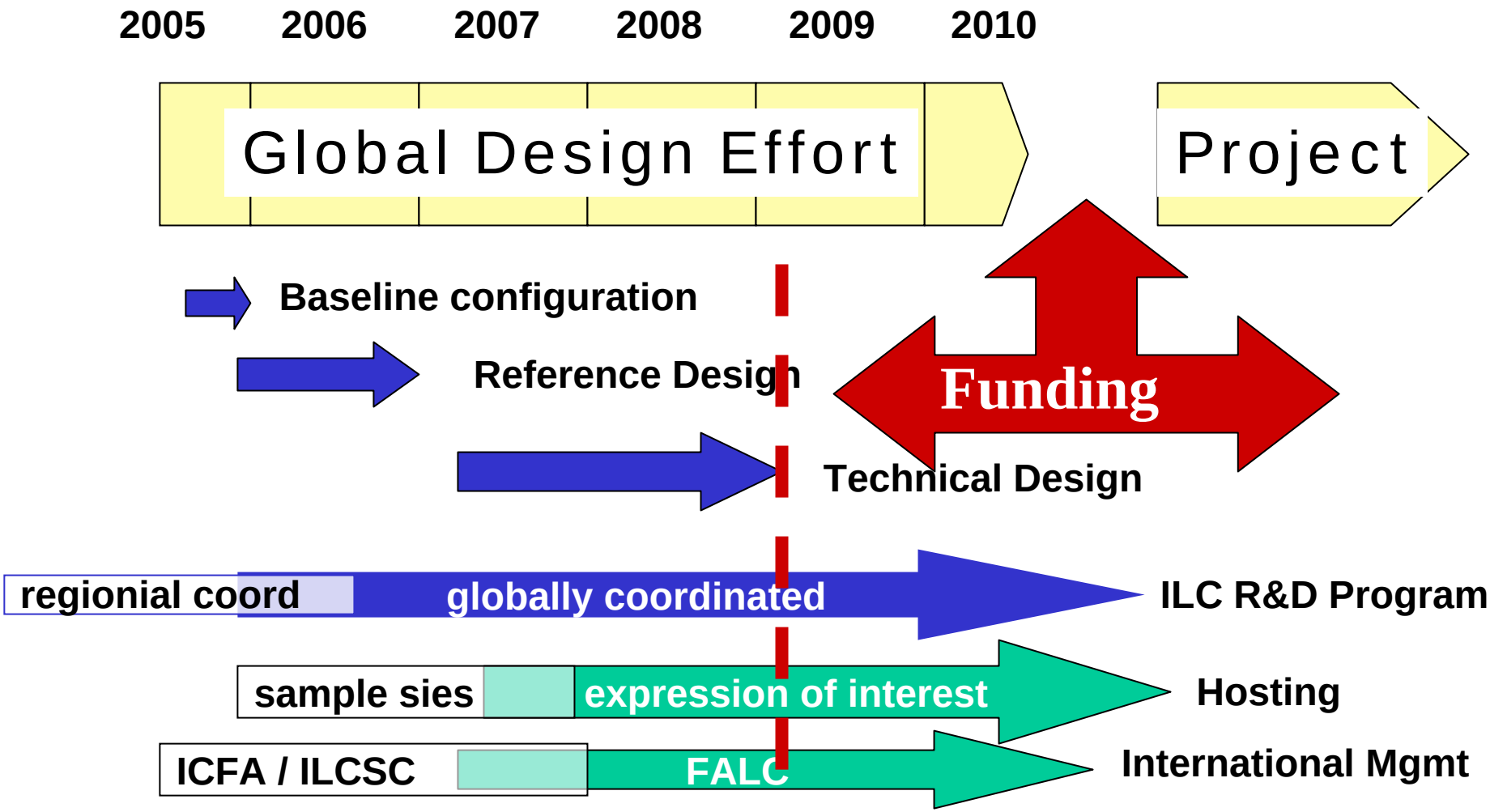
Critical choices: luminosity parameters & gradient

Baseline Configuration Document Review Process

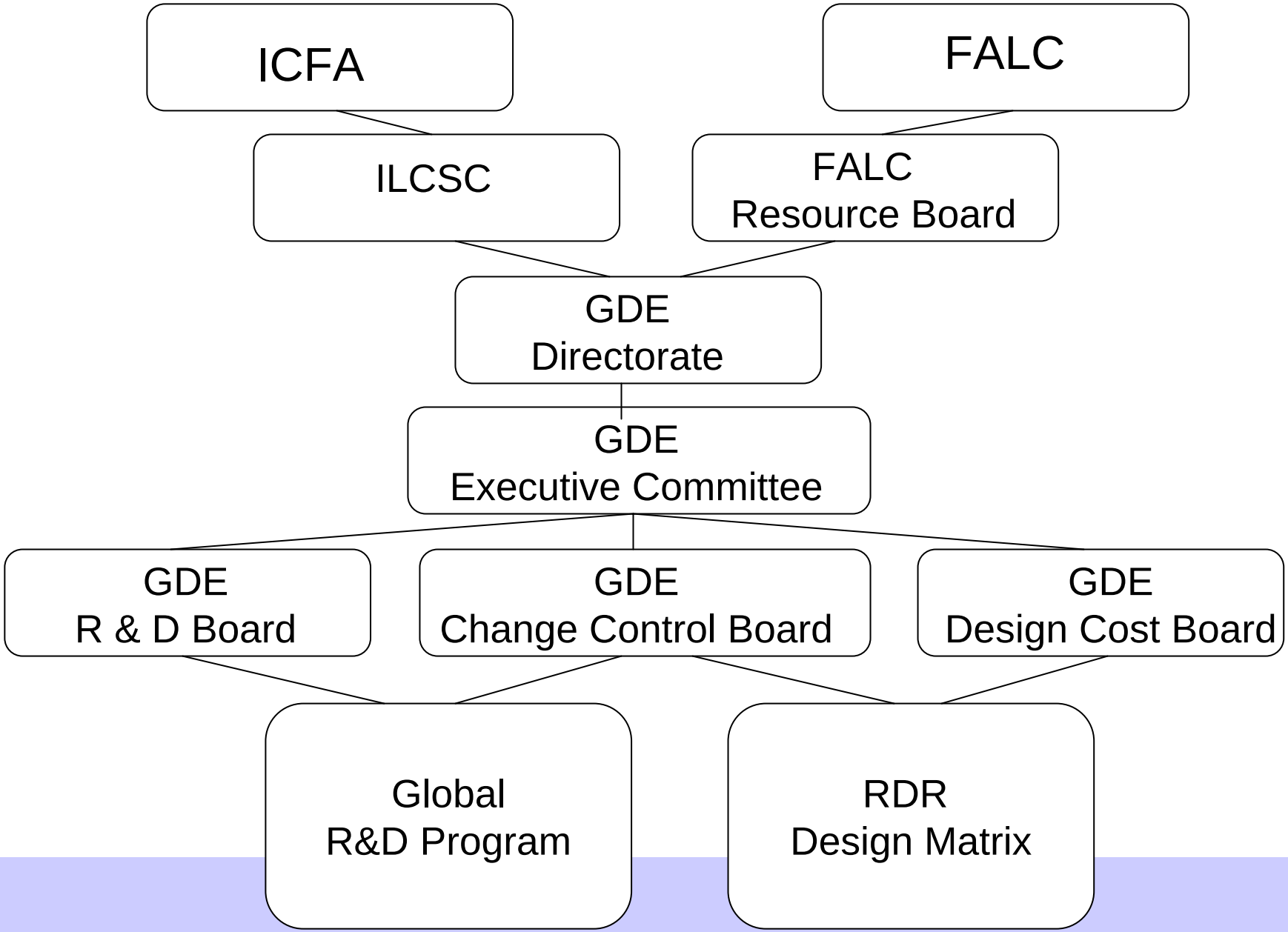
- BCD executive committee has monitored BCD progress
  - Review WG/GG summary write-ups (recommendations)
  - Review each question on the list of 40+ decisions
- BCD EC identified and solicited needed additional input
  - Commissioned 5 “white papers”
  - Invited independent reviewers (Oide, Richter & Rivkin)
- Strawman BCD available mid-November
- Presentation of strawman BCD at Frascati GDE meeting (Dec. 10-12)

- Final agreed BCD to be documented by end of 2005
- Final BCD becomes property of ‘Change Control Board’ in early 2006
- Reference Design to be completed by end of 2006

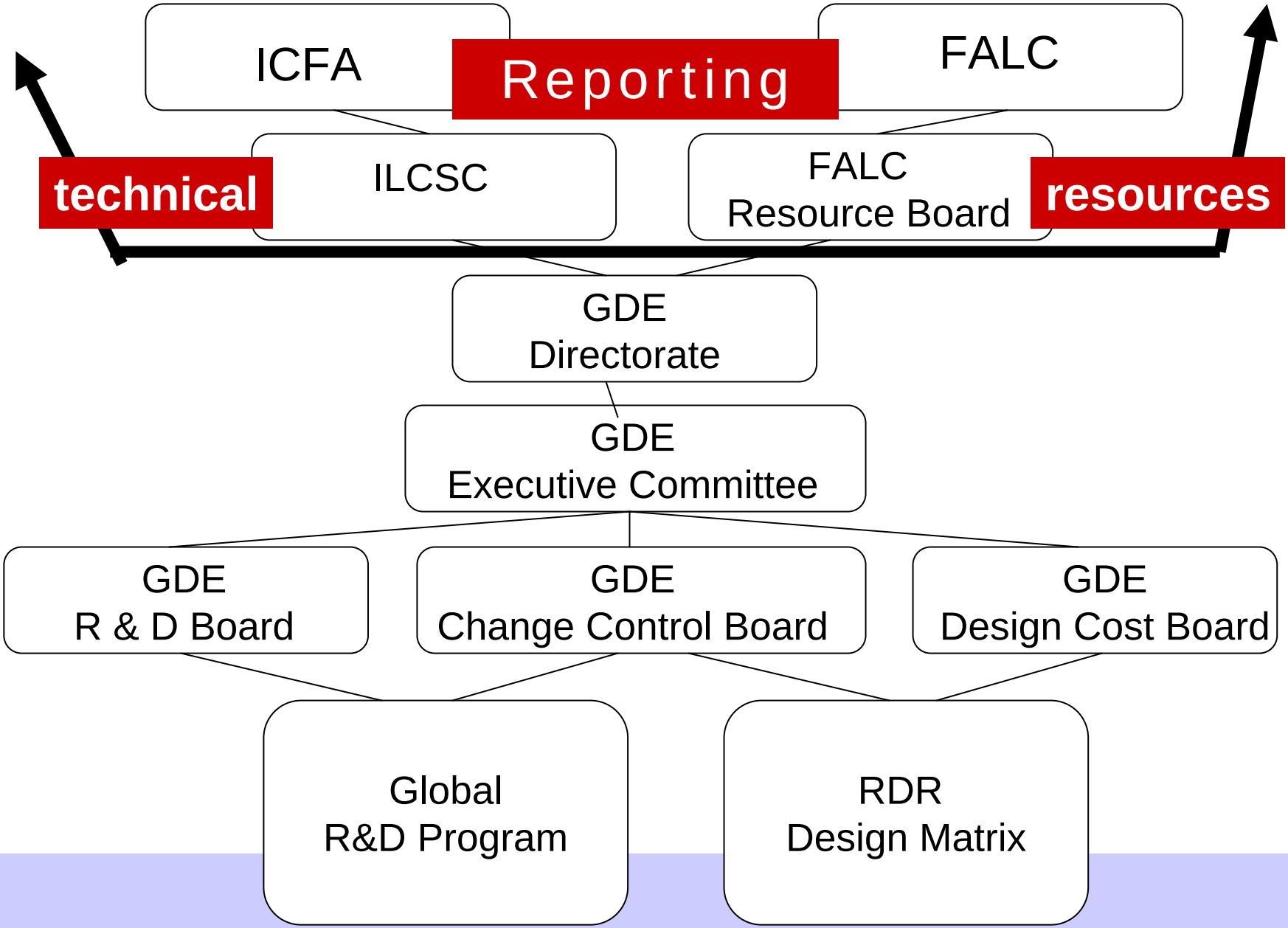
The GDE Plan and Schedule



GDE RDR / R&D Organization

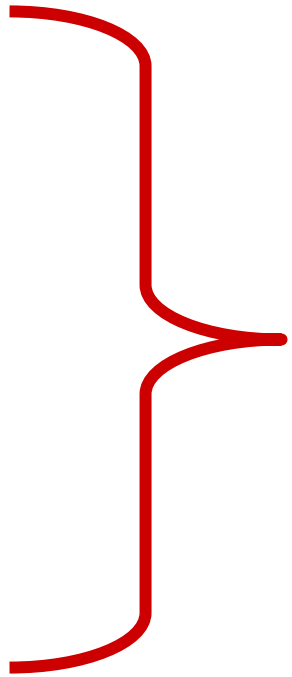


GDE RDR / R&D Organization



GDE Structure and Organization

- Executive Committee for Baseline Configuration
  - GDE Director
    - Barish
  - Regional Directors
    - Dugan – Americas
    - Foster – Europe
    - Takasaki – Asia
  - Accelerator Leaders
    - Yokoya - Asia
    - Raubenheimer - Americas
    - Walker - Europe



GDE Executive Committee

- Responsible for decisions and documentation for the Baseline Configuration Document (BCD)

GDE Structure and Organization

- GDE Groups
  - Design / Cost Engineers
    - Shidara – Asia
    - Bialowons – Europe
    - Garbincius – Americas
  - Siting, Civil Construction and Infrastructure
    - Baldy - Europe
    - Enomoto – Asia
    - Kuchler – Amercas
  - Physics / Detectors (WWS chairs)
    - Brau - Americas
    - Richard - Europe
    - Yamamoto - Asia
  - Accelerator Experts (44 GDE members)

GDE Organizational Evolution for RDR

- Selected additions to the GDE following the BCD completion having needed skills in design, engineering, costing, etc
- Change Control Board
  - The baseline will be put under configuration control and a Board with a single chair will be created with needed expertise.
- Design / Cost Board
  - A GDE Board with single chair will be established to coordinate the reference design effort, including coordinating the overall model for implementing the baseline ILC, coordinating the design tasks, costing, etc.
- R&D Board
  - A GDE Board will be created to evaluate, prioritize and coordinate the R&D program in support of the baseline and alternatives with a single chair

Change Control Board (CCB)

Nobu Toge (chair)

- The Change Control Board is responsible for maintaining the baseline configuration as defined in the Baseline Configuration Document. The first action of the CCB will be to finalize the BCD and put it under configuration control. In addition to maintaining the baseline, the CCB will assess R&D projects defined in the BCD that potentially can lead to improvements over the baseline in cost or performance. The CCB will define what needs to be demonstrated in these R&D projects, in order to be considered for a CCB action to replace the baseline.

- The CCB will work with the GDE EC to formalize levels for taking change control actions. Major changes in the baseline defined as changing costs by more than $100M or make significant changes in performance, schedule or risk will be recommended to the Director and GDE EC for final approval. For all other changes, the CCB will be the final authority.

Design Cost Board (DCB)

Peter Garbincius (chair)

- The Design / Cost Board will be responsible for assessing and providing guidance for the overall RDR design effort program. The DCB initial goals will be to propose the overall structure and content for the RDR document to be developed by the end of 2006. It also will provide early guidance required to enable the design / cost effort to get fully underway by the time of the Bangalore GDE meeting.
- The DCB will set goals and milestones for producing the RDR, conduct design reviews and provide guidance and assessments of the RDR effort. The DCB will report to the Director and EC regularly as the design / cost effort progresses, reporting on early evaluations of costs, problems and changes needed in the BCD, etc.

Design Approach

- Create a baseline configuration for the machine
  - Document a concept for ILC machine with a complete layout, parameters etc. defined by the end of 2005
  - Make forward looking choices, consistent with attaining performance goals, and understood well enough to do a conceptual design and reliable costing by end of 2006.
  - Technical and cost considerations will be an integral part in making these choices.
  - Baseline will be put under “configuration control,” with a defined process for changes to the baseline.
  - A reference design will be carried out in 2006. I am proposing we use a “parametric” design and costing approach.
  - Technical performance and physics performance will be evaluated for the reference design

Parametric Approach

- Parametric approach to design
  - machine parameters : a space to optimize the machine

		min		nominal		max	
Bunch charge	N	1	-	2	-	2	$\times 10^{10}$
Number of bunches	n_b	1330	-	2820	-	**5640**	
Linac bunch interval	t_b	**154**	-	308	-	461	ns
Bunch length	σ_z	**150**	-	300	-	500	μm
Vert.emit.	$\gamma\epsilon_y^*$	**0.03**	-	0.04	-	0.08	mm·mrad
IP beta (500GeV)	β_x^*	**10**	-	21	-	21	mm
	β_y^*	**0.2**	-	0.4	-	0.4	mm
IP beta (1TeV)	β_x^*	**10**	-	30	-	30	mm
	β_y^*	**0.2**	-	0.3	-	0.6	mm

  - Trial parameter space, being evaluated by subsystems

  - machine design : incorporate change without redesign; incorporates value engineering, trade studies at each step to minimize costs

Global R&D Board (RDB)

Bill Willis (chair)

- The Global R&D Board will be responsible for assessing and providing guidance for the overall R&D program. The RDB will suggest priorities for the research facilities and R&D supporting the baseline, the R&D on alternatives to the baseline and selective R&D that could further the field in the longer term. The mission will also include global assessments and recommended priorities for the detector R&D program and evaluate the balance between accelerator and detector R&D.

- The RDB will develop a proposal driven program, structured in the sense of defined goals, and milestones, and resources evaluated on a common basis to allow comparison across different regions and national funding systems. It will conduct reviews and identify gaps in coverage of topics, resource or technical issues, duplications, and other concerns.

Approach to ILC R&D Program

- Proposal-driven R&D in support of the baseline design.
  - Technical developments, demonstration experiments, industrialization, etc.
- Proposal-driven R&D in support of alternatives to the baseline
  - Proposals for potential improvements to the baseline, resources required, time scale, etc.
- Develop a prioritized DETECTOR R&D program aimed at technical developments needed to reach combined design performance goals

Area Systems

Region Leaders for Systems

e- source	e+ source	Damping Rings	RTML	Main Linac	BDS
	Kuriki	Gao	E.S. Kim	Hayano	Yamamoto (MDI Ch)
???		Guiducci	PT	Lilje	Angal-Kalinin
				Adolphsen	
Brachmann	Sheppard	Wolski		Solyak	Seryi

Technical Systems	Regional Coordinators for RDR		
Vacuum systems	Suetsugu	Michelato	Noonan
Magnet systems	Sugahara	BINP ??	Thompkins
Cryomodule	Ohuchi	Pagani	Carter
Cavity Package	Saito	Proch	Padamsee
RF Power	Fukuda	Saclay ??	Larsen
Instrumentation	Urakawa	Burrows	Ross
Dumps and Collimators	KEK	??	??
Accelerator Physics	Kubo	Schulte	??
Global Systems			
Commissioning, Operations & Reliability	Terunuma	Elsen	Himel
Control System	Michizono	Simrock	*Carwardine*
Cryogenics	Hosoyama	Tavian	Peterson
CF&S	Enomoto	Baldy	Kuchler
Installation	Shidara	Bialwons	??

RDR design matrix

	Area Systems					
Technical Systems	**e- source**	**e+ source**	**Damping Rings**	**RTML**	**Main Linac**	**BDS**
Vacuum systems						
Magnet systems						
Cryomodule						
Cavity Package						
RF Power						
Instrumentation						
Dumps and Collimators						
Accelerator Physics						
Global Systems						
Commissioning, Operations & Reliability						
Control System						
Cryogenics						
CF&S						
Installation						

Cost evaluation

- inclusive – can't neglect anything important
- "parametric" – quantities, escalation, overheads, labor rates, cost vs size or performance (e.g. gradient)
- how does cost vary with a performance parameter? e.g. # bunches?
- bottom-up – some elements, but many will be top-down, scaled, parametric, etc.
- flexible – easily follow any scope changes !!!

Value (rather than cost)

- Value is worth to the ILC project,
  rather than worth to contributing country
- Approach developed by ITER (R. Aymar)
  vetted through Dan Lehman (US DOE)
- Countries bid to provide some piece of
  project and not funds. Internally apply their own overheads, contingency, and labor rates
  to determine their cost, without changing value
- Yes, ITER has common fund (some % of value assessment–acts as management contingency)

Moving forward…

- "Strawman" BCD → BCD (now)
  - Ownership of BCD → CCB They now take responsibility for the content changed and/or added. Final version by Bangalore at which point only formal change control requests.

Communications:

  - ILC NewsLine, postings on ILC website
  - Brochure, informational materials, etc
  - Logo
- Venues / Dates of future GDE meetings
  - Bangalore, India 9-11 March
  - Vancouver, Canada 18-20 July
  - Valencia, Spain 6-8 November

BCD Status (1)

- Excellent description of the collider
  - Many critical issues identified in past reviews resolved
  - Very solid design but …
- Still outstanding accelerator physics questions
  - Need to separate BCD from further design development within the next month or two
    - Need a design to cost
    - Area Systems develop the BCD
    - Working Groups (may) continue working on design improvements
    - Watch out for resource conflicts – RDR is a huge job

BCD Status (2)

- Still inconsistencies – natural from design process
  - Need an iteration of global optimization
  - Parameters need to be fixed (discuss at end)
  - Matching between subsystems needs work
- Level of detail varies in documentation
  - Need schematics and tables of defining parameters
  - Needs to be addressed quickly –
    - Changes will be implemented by CCB
    - Want these submitted before end of January, 2006
  - Lattices and component specs are needed later

Site Differences

- Differences will arise because of the site dependence
  - Wherever possible make the choice with the most in common
    - Cannot carry too many separate configurations
    - Biggest impact on the conventional facilities and civil design
      - Choices in ac power distribution, cooling, etc
      - Location of injectors (centralize these?)
      - Terrain following in linac
      - Location of surface construction probably doesn't matter
  - What about hardware designs
    - Nuts, bolts, pipe sizes, etc
      - Get advice from LHC
      - Want to develop plug-n-play components
      - Probably not too many cases that will arise

R&D Basis

- Technology choices relatively conservative
  - However there are still many extrapolations
    - Cavity gradient clearly pushed
    - MBK klystrons are not yet fully developed
    - Instrumentation is state-of-the art in many cases
    - Cryomodule based on Type IV …
  - Important to understand risks to cost and performance
    - I’m not suggesting a more conservative solution!
  - Very important to continue ACD but also to understand how changes impact the larger system

Parameter Range

- Established the range in February 2005 with the goal
  - Establish an operating range to deal with ‘real world’ problems
  - Allow optimization of the collider for different measurements
  - http://www-project.slac.stanford.edu/ilc/acceldev/beamparameters.html
  - Nominal, LowQ, LargeY, LowP, HighRate, HighL

Parameters (1)

- Nominal
  - Very similar to TESLA and USLCTOS parameters
    - 2820 bunches
    - Roughly 10 mA beam current
    - 2e10 per bunch
    - 650 x 5.7 nm IP spots
- LowQ
  - Low disruption (Dy~10) and low beamstrahlung
  - Short IP bunch length
  - Low single bunch charge
    - 5600 bunches
    - Roughly 10 mA beam current
    - 1e10 per bunch – ~150 ns linac bunch spacing
    - 500 x 3.5 nm IP spots

Parameters (2)

- LargeYspot
  - Allows for large emittance growth in LET and larger bunch length
    - 2820 bunches
    - 500 x 8 nm IP spots
- LowPower
  - Reduced beam power and number of bunches
  - Could trade rf pulse length or average current
    - 1300 bunches
    - Large beamstrahlung – almost 6%
- HighLuminosity
  - Requires meeting all specs (unlikely)
    - 5e34 luminosity

Parameter Range Summary

- Two subsystems have difficulty:
  - High luminosity parameters have impact on the BDS and extraction lines
  - Damping rings have difficulty with lowQ parameters

Discussion Session

- Communications:
  - ILC NewsLine, postings on our website – give inputs
  - Brochure, informational materials, etc
  - Logo

- Venues / Dates of future GDE meetings
  - Bangalore, India 9-11 March
  - Vancouver, Canada 18-20 July
  - Valencia, Spain 6-8 November

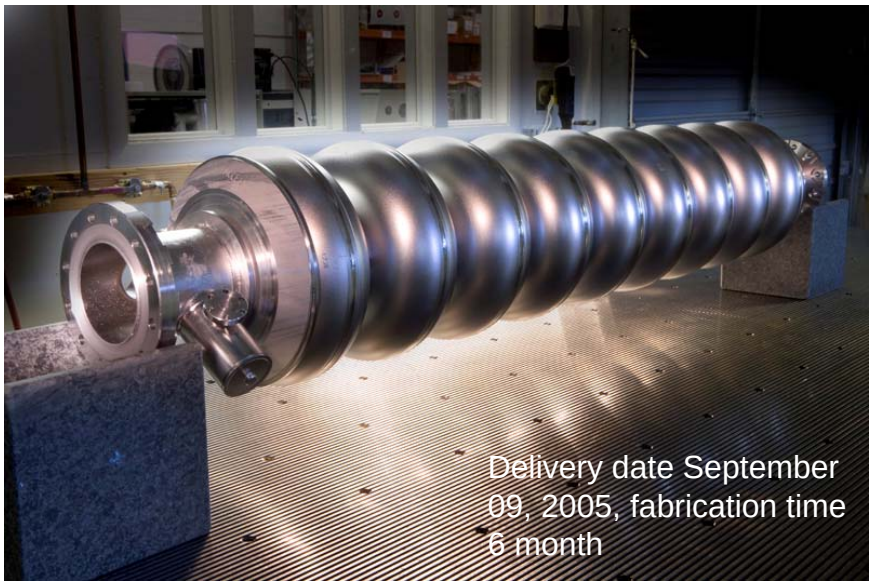
Fermilab and the RDR

- ILC Main Linac Lattice and Low Emittance Transport Studies.
  - Full linac simulation including feedback, beam-beam interaction at IR.
  - Cryogenics, systems engineering
- US-ILC site development
  - Considering several sites around Fermilab
- Alignment and Vibration
  - Systematic Data collection and analysis
  - Measurement of vibration from surface to ILC Depth near Fermilab site.
- Damping Ring
  - Lattice Design, Instabilities, Cost etc.
- Machine Detector Interface and Energy Deposition Studies
  - Energy Deposition and collimation for BDS and IR
  - Background in detector and its mitigation
  - Treatment of the spent beam downstream of IR.

SCRF ILC EFFORT at Fermilab

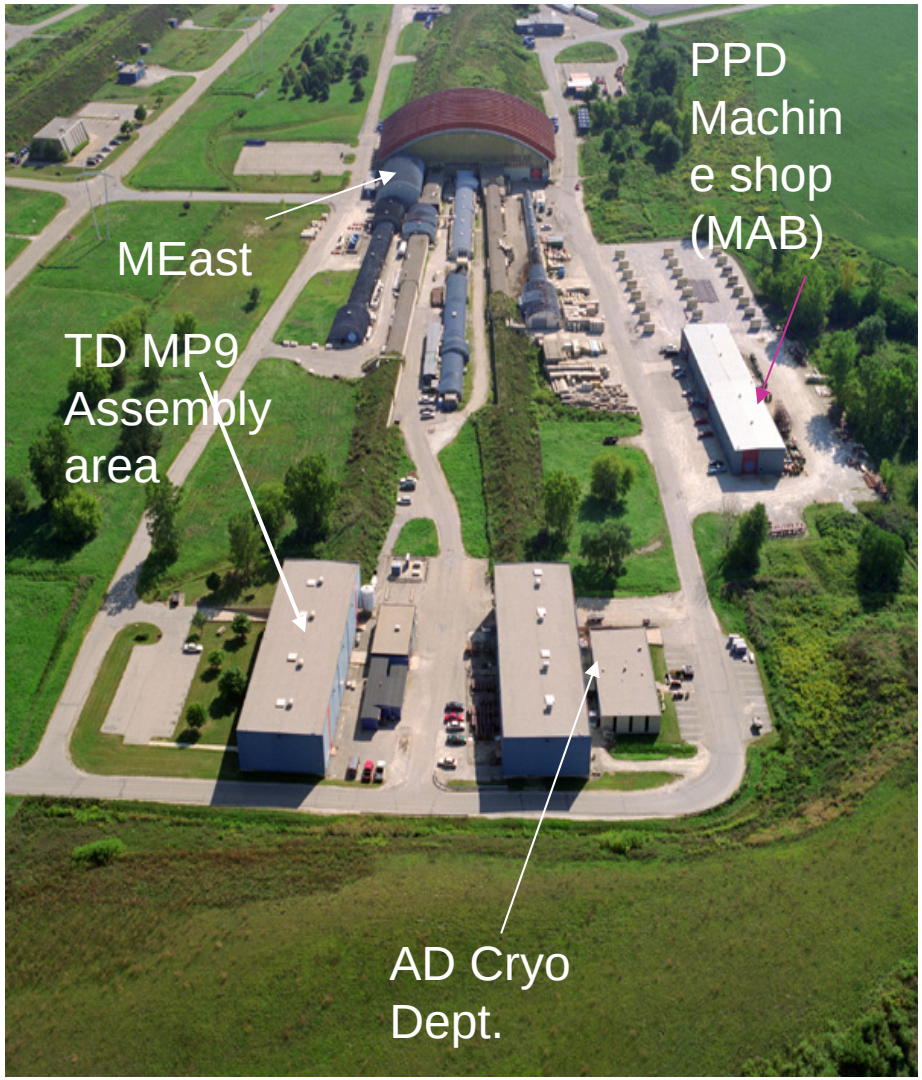
- The buildings exist at Fermilab: need infrastructure to be built up: rf power, cryogenics, clean rooms, beam test facility
- Integrate into national effort: JLab, ANL, Cornell
- View SCRF infrastructure at Fermilab and the Main Linac design effort as a Package Deal:
  - Learn how to fabricate (in the US) SCRF modules with 35 MV/m, Q = 0.5-1e10
  - Develop capabilities to fully test the basic building blocks of the Main Linac including the Superconducting RF, RF power, LLRF, Instrumentation, Feedback and Controls for Main Linac

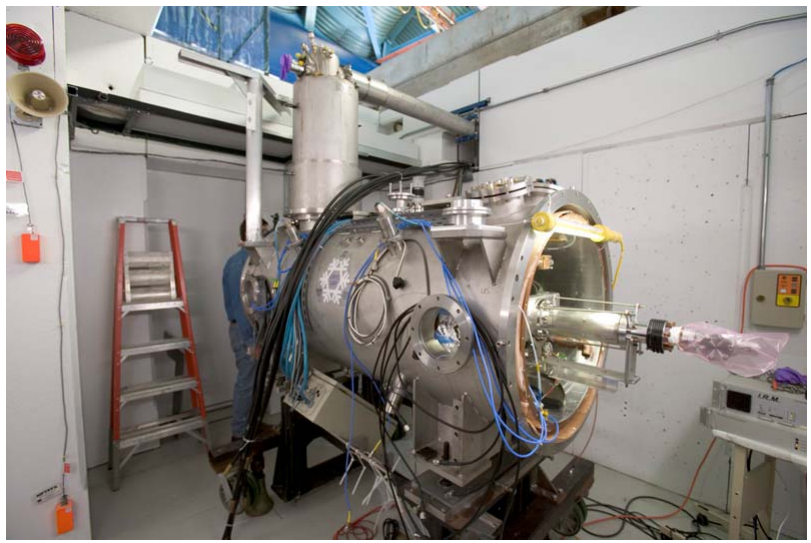
ILC 1.3 GHz Cavities @ FNAL



- Industry to fabricate cavities.
- Cavities will undergo BCP and vertical testing at Cornell (25 MV/m)
- EP and vertical testing at Jlab. (35 MV/m)
- BCP facility being developed at ANL/Fermilab (in late 06)
- High Power Horizontal test will be performed at Fermilab.

ILCTA Infrastructure at FNAL



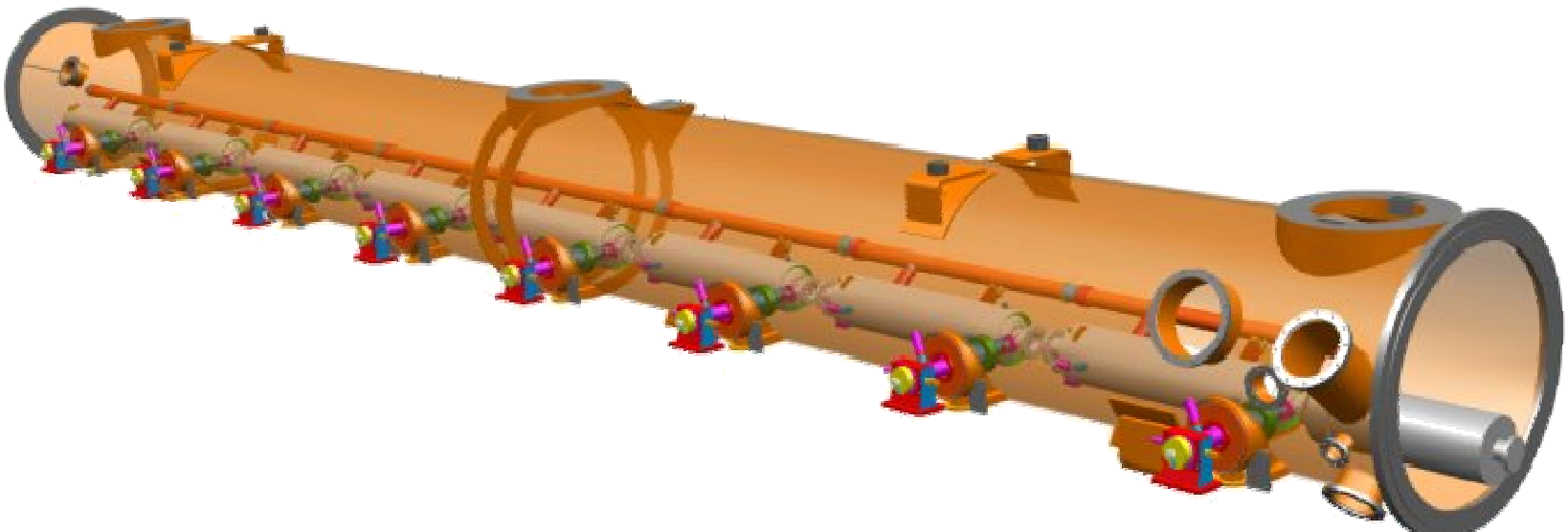


Cryomodule Design and Fabrication

- In FY05 Fermilab started on converting the DESY/INFN design of the ILC cryomodule (Type-III+) for US vendor and cost reduction.

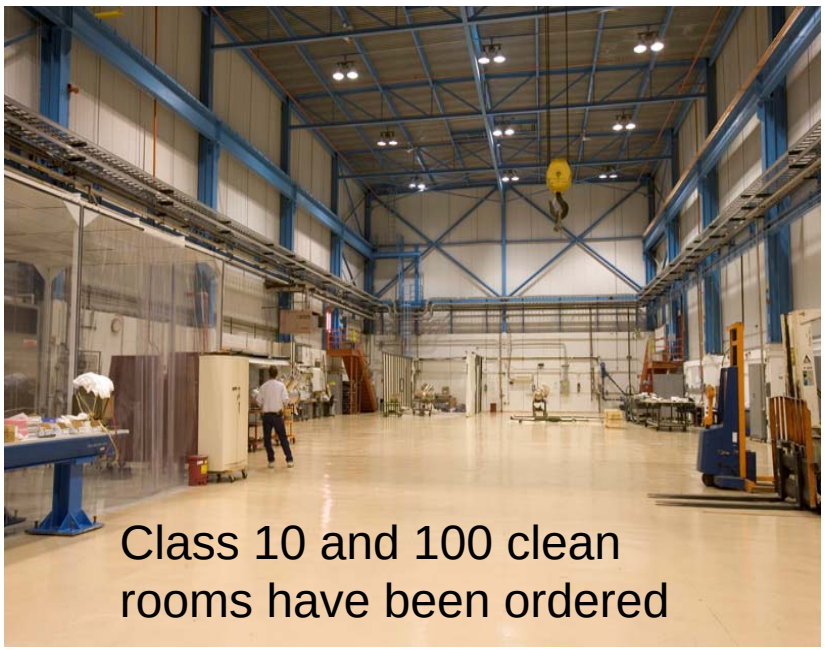
- The cryomodule is the significant cost in the Main Linac. Industrial fabrication and cost reduction are important issues that we need to start now.

- The Goal is to design an improved ILC cryomodule (Type-IV).



ILCTA@Fermilab - Cryomodule Assembly Facility

- Cavity will be dressed in CAF for horizontal test at Fermilab at ILCTA-MDB.
- Horizontally tested cavities will be assembled into a string at CAF.
- Cryomodule fabrication takes place at CAF.



- This facility is designed based on improved design from DESY.
- We can start fabrication of Cryomodule by May 06.

Beam test plans

New Muon Lab – need a new name!

FNPL Photo-injector

Building a dedicated ILC cryomodule test in the New Muon Lab

- Cleaning out building (Done) except for CCM
- Plan is to install interim cryogenic solution in FY06
- Move FNPL Photo-injector to provide electron beam (Late FY06)

Fermilab and the ILC

- Formally the project is lead by Bob Kephart
- Interactions and Communications:
  - Sergei Nagaitsev will be in charge of RF and ILCTA@Fermilab (beam test area in New Muon).
    - We plan to meet weekly for the next few months
    - He has agreed to give a presentation at a CD meeting soon (TBA)
  - John Carwardine from Argonne will be the Controls Coordinator for the Americas
  - Peter Garbincius is the head of Design Cost Board (DCB)
  - Nikolay Solyak is the Fermilab Linac Area Coordinator
- We must learn to work with many different collaborations and coordinators: SMTF, TTC, GDE, GG2, GDE Area groups, ILC Technical groups, ILC Global Groups, GDE Boards, TD, AD, PPD…