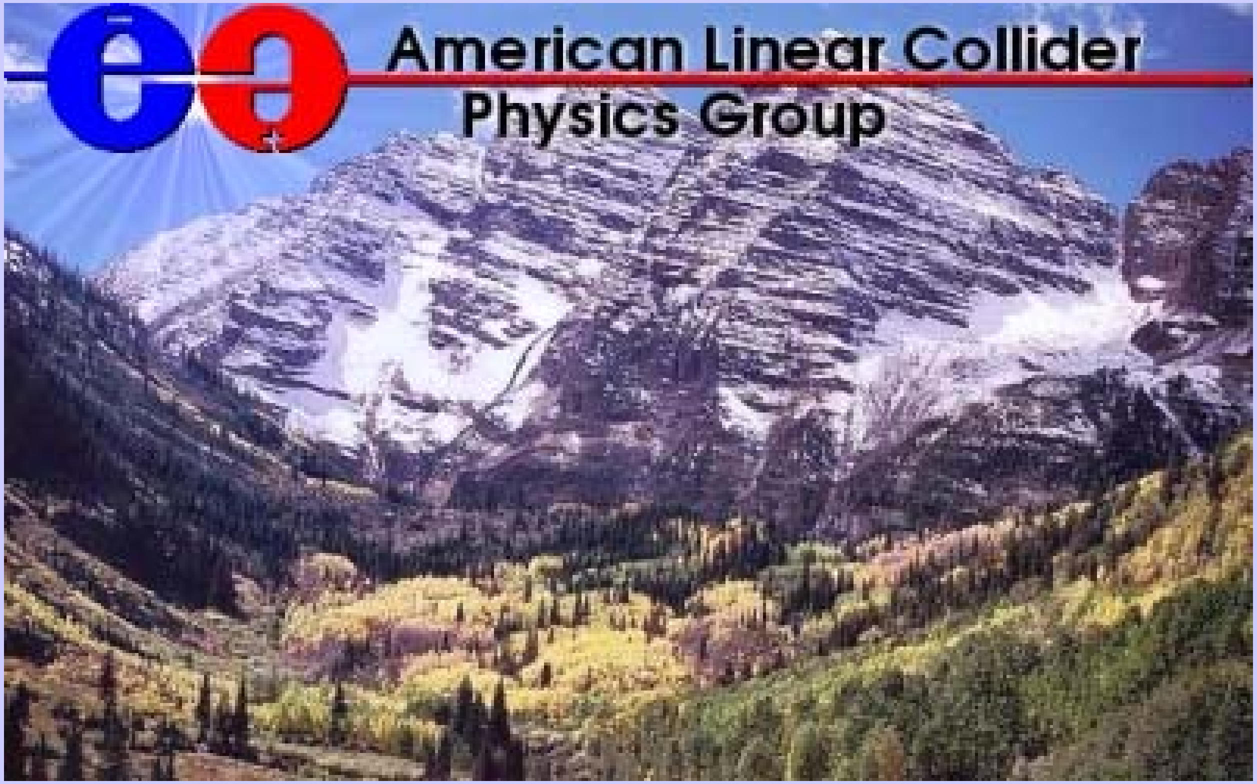
Report from the GDE director



2005 International Linear Collider Physics and Detector Workshop
and Second ILC Accelerator Workshop
Snowmass, Colorado, August 14-27, 2005

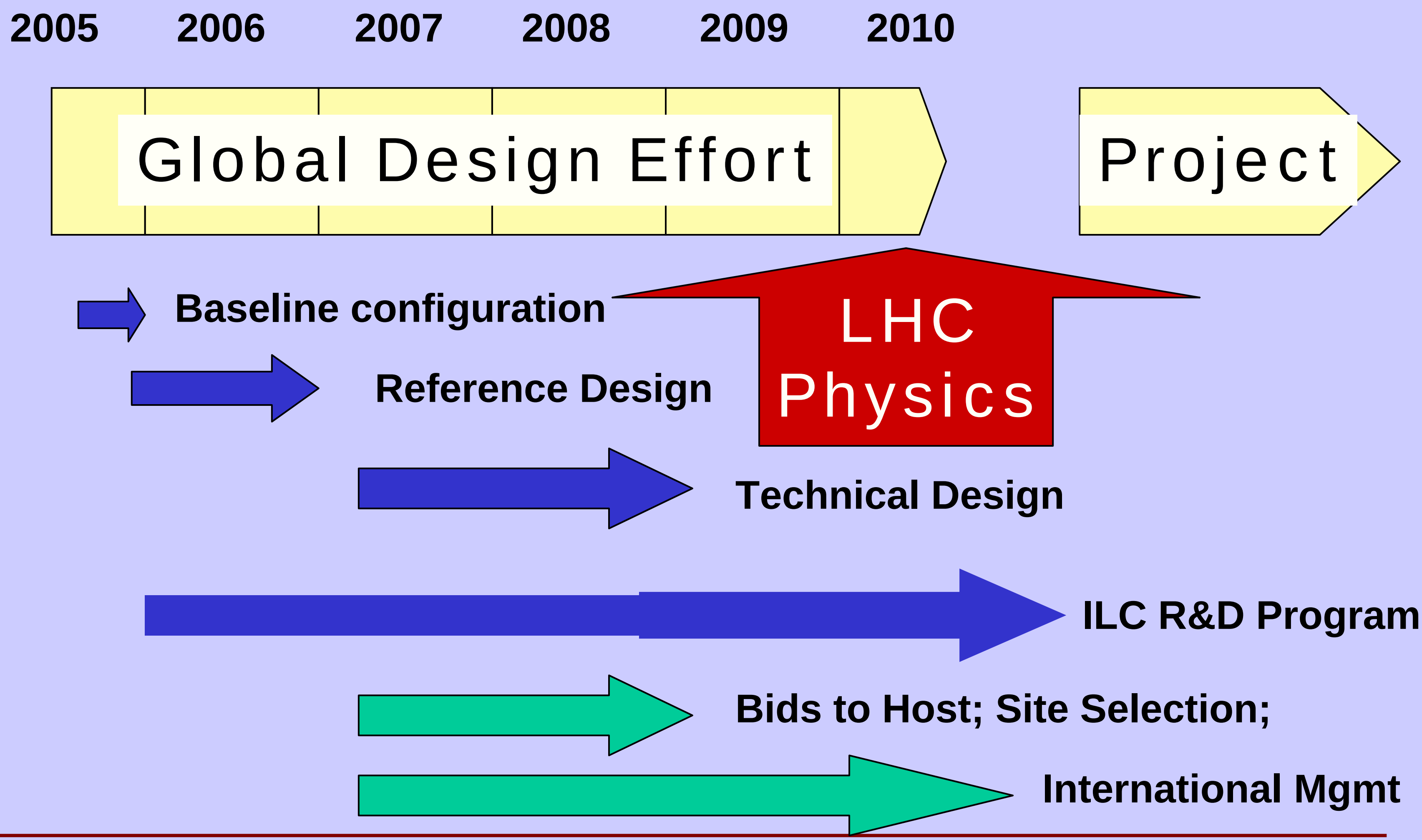
Barry Barish

Snowmass
14-Aug-05

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.)**

The GDE Plan and Schedule



GDE – Staffing

- **Staff the GDE**
  - **Administrative, Communications, Web staff**
  - **Regional Directors (one per region)**
  - **Accelerator Experts (covering all technical areas)**
  - **Senior Costing Engineer (one per region)**
  - **Civil/Facilities Engineer (one per region)**
  - **Detectors (WWS chairs)**
  - **Fill in missing skills (later)**
- **Total staff size about 20 FTE (2005-2006) about 40 heads.**
- **The internal GDE organization and tasks will be organized internationally, not regionally**

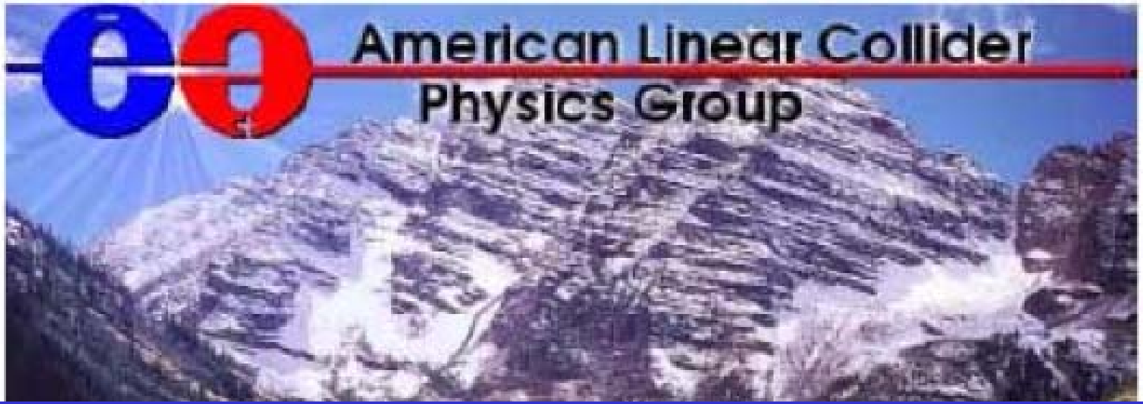
GDE – Near Term Plan

- **Schedule**
  - **Begin - define Configuration (Snowmass Aug 05)**
  - **Baseline Configuration Document (end of 2005)**

  - **Baseline under Configuration Control (Jan 06)**
  - **Develop Reference Design (end of 2006)**
  - **Coordinate the supporting R&D program**

- **Three volumes -- 1) Reference Design Report; 2) Shorter glossy version for non-experts and policy makers ; 3) Detector Concept Report**

Snowmass Workshop – Aug 2005

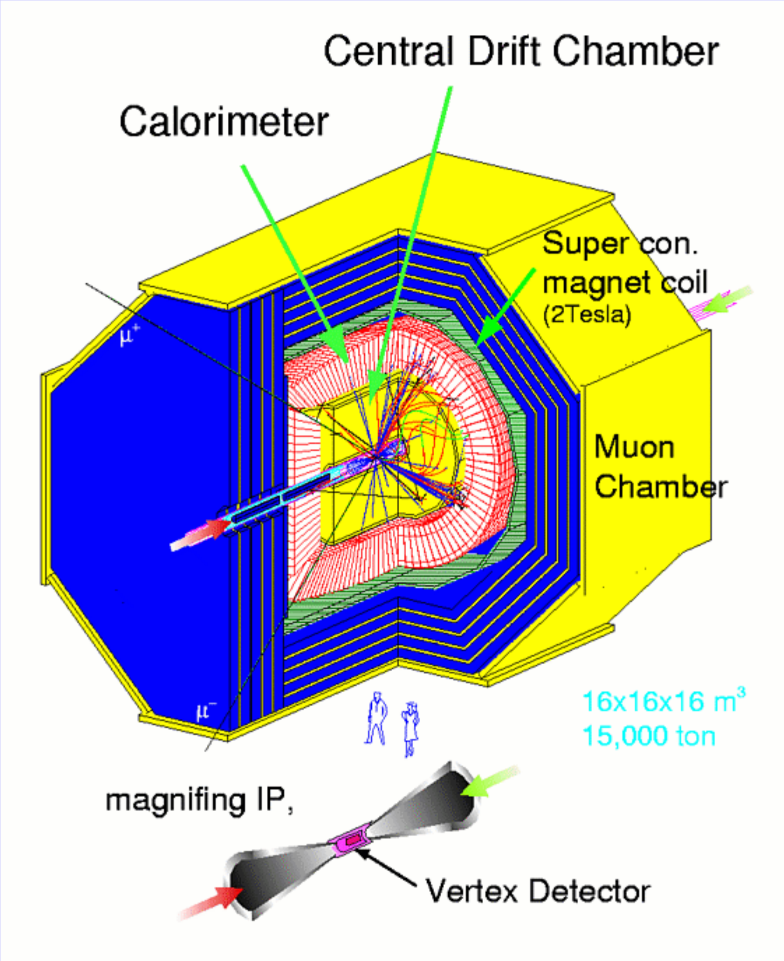


Plans for this Snowmass workshop preceded the creation of the GDE and it remains organized as a general workshop on all aspects of the ILC. The GDE is taking advantage of this workshop to hold its first meeting within this broad community forum

GOALS
Physics and Detector Workshop

- **To develop the Linear Collider detector studies with precise understanding of the technical details and physics performance of candidate detector concepts, as well as the required future R&D, test beam plans, machine-detector interface and beamline instrumentation, cost estimates, and other aspects.**

Detector Concepts and Challenges

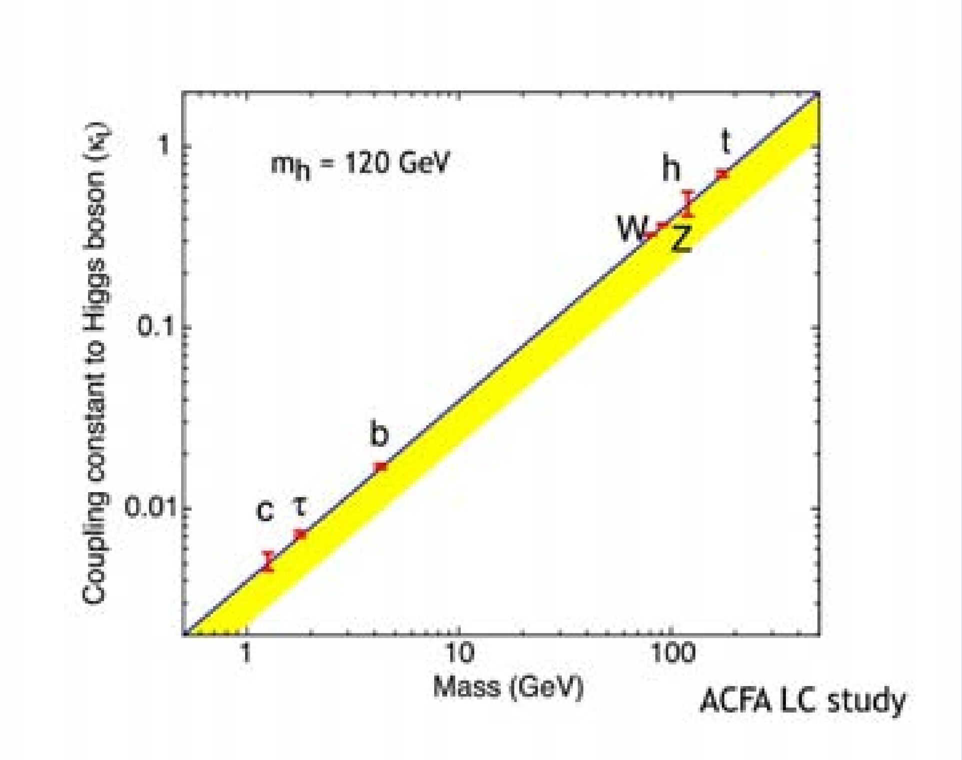


- Three concepts under study
- Typically requires factors of two or so improvements in granularity, resolution, etc. from present generation detectors
- Focused R&D program required to develop the detectors -- end of 2005
- Detector Concepts will be used to determine machine detector interface, simulate performance of reference design vs physics goals next year.

GOALS
Physics and Detector Workshop

- **To advance the Linear Collider physics studies, including precision calculations, synergy with the LHC, connections to cosmology and astrophysics, and relationships to the detector design studies.**

Higgs Coupling and Extra Dimensions



- ILC precisely measures Higgs interaction strength with standard model particles.
- Straight blue line gives the standard model predictions.
- Range of predictions in models with extra dimensions -- yellow band, (at most 30% below the Standard Model
- The models predict that the effect on each particle would be exactly the same size.
- The red error bars indicate the level of precision attainable at the ILC for each particle
- Sufficient to discover extra dimensional physics.

GOALS
Physics and Detector Workshop

- **To facilitate and strengthen the broad participation of the community in Linear Collider physics, detectors, and accelerators, and engage the greater public in the excitement of this work.**

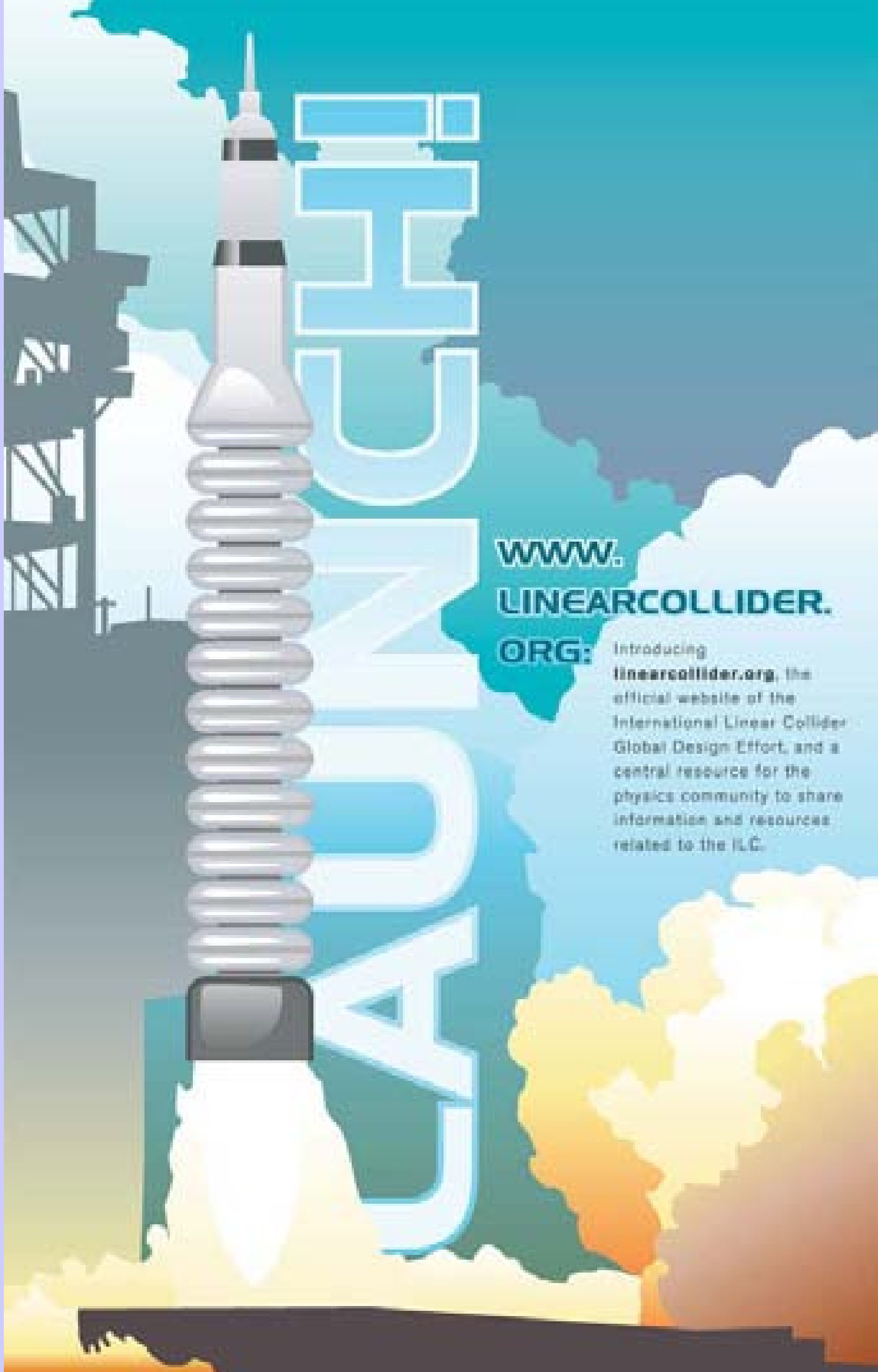
ILC Communications

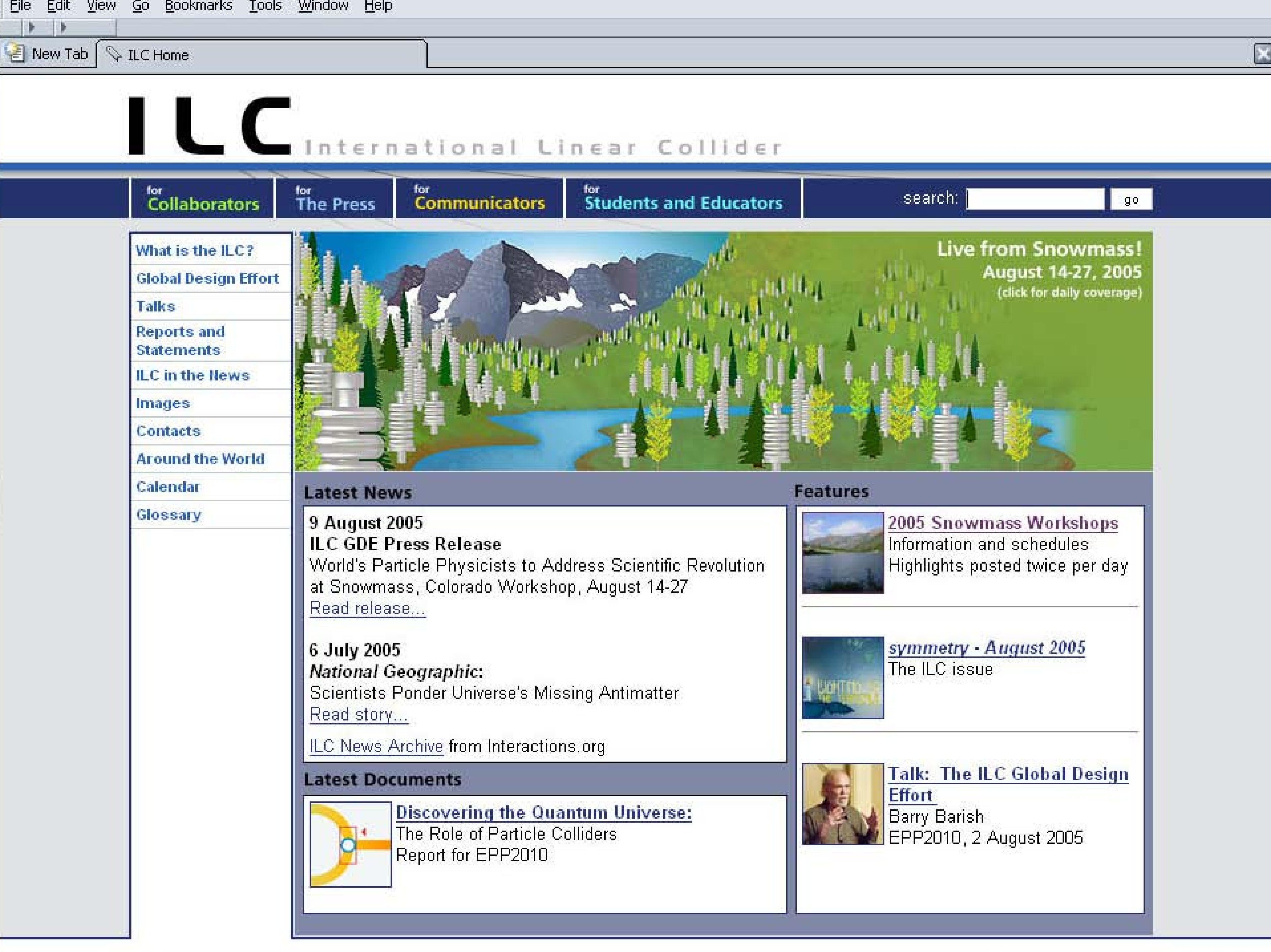
- **Launch New ILC Website**

  www.linearcollider.org
  - **thanks to Norm Graf for url**

- **"One Stop Shopping"**
  - **electronic data management system (EDMS), news, calendar of events, education and communication,**

- **Designer**
  - **Xeno Media (Kevin Munday)**

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New Tab
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International Linear Collider
for Collaborators
for The Press
for Communicators
for Students and Educators
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What is the ILC?
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August 14-27, 2005
(click for daily coverage)
Latest News
9 August 2005
ILC GDE Press Release
World's Particle Physicists to Address Scientific Revolution at Snowmass, Colorado Workshop, August 14-27
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6 July 2005
National Geographic:
Scientists Ponder Universe's Missing Antimatter
Read story...
ILC News Archive from Interactions.org
Latest Documents
Discovering the Quantum Universe:
The Role of Particle Colliders
Report for EPP2010
Features
2005 Snowmass Workshops
Information and schedules
Highlights posted twice per day
symmetry - August 2005
The ILC issue
Talk: The ILC Global Design Effort
Barry Barish
EPP2010, 2 August 2005

ILC Newsline

Subscribe at http://www.linearcollider.org

The First ILC Workshop

Nov 13-15, 2004

~ 220 participants from 3 regions, most of them accelerator experts

15

Snowmass – GDE Groups

- 'Global Groups' are being formed, in addition to the 7WGs (sub-system working groups)

Subsystem Working Groups		Global Groups	
WG1	Beam dynamics from DR exit to IP, incl. bunch compressor design	GG1	Parameters, layout
WG2	Linac except cavities	GG2	Instrumentation
WG3a	Particle sources (e^-, e^+)	GG3	Reliability, MPS, availability, etc.
WG3b	Damping ring	GG4	Cost engineering
WG4	Beam delivery	GG5	Civil engineering
WG5	Accelerating cavities	GG6?	Options (γ-γ, e^-e^-, GigaZ, etc)
WG6	Communication		

Parameters for the ILC

- E_{cm} adjustable from 200 – 500 GeV
- Luminosity → $\int L dt$ = 500 fb^{-1} in 4 years
- Ability to scan between 200 and 500 GeV
- Energy stability and precision below 0.1%
- Electron polarization of at least 80%

- The machine must be upgradeable to 1 TeV

TESLA Cavity

~1m

9-cell 1.3GHz Niobium Cavity

Reference design: has not been modified in 10 years

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 “parametic” design and costing approach.**
  - **Technical performance and physics performance will be evaluated for the reference design**

Configuration Parameter Space

Beam and IP parameters for 500 GeV cms

	TESLA	USSC	Nominal	Low Q	Large Y	Low P	High L
E_{cms} (GeV)	500	500	500	500	500	500	500
N (10^{10})	2.0	2.0	2.0	1.0	2.0	2.0	2.0
n_b	2820	2820	2820	5640	2820	1330	2820
t_b (ns)	336.9	336.9	307.7	153.8	307.7	461.5	307.7
bucket interval	438	438	400	200	400	600	400
I_{ave} (mA)	9.5	9.5	10.4	10.4	10.4	6.9	10.4
Gradient	23.4	28.0	30.0	30.0	30.0	30.0	30.0
$\gamma\epsilon_x$ (mm·rad)	10	9.6	10	10	12	10	10
$\gamma\epsilon_y$ (mm·rad)	0.03	0.04	0.04	0.03	0.08	0.035	0.03
β_x^* (mm)	15	15	21	12	10	10	10
β_y^* (mm)	0.4	0.4	0.4	0.2	0.4	0.2	0.2
σ_x^* (nm)	554	543	655	495	495	452	452
σ_y^* (nm)	5.0	5.7	5.7	3.5	8.1	3.8	3.5
σ_z (μm)	300	300	300	150	500	200	150
D_x	0.226	0.235	0.162	0.0708	0.468	0.226	0.170
D_y	25.3	22.3	18.5	10.0	28.6	27.0	21.9
Υ_{ave}	0.054	0.055	0.046	0.061	0.036	0.100	0.133
δ_{BS}	0.030	0.031	0.022	0.018	0.024	0.057	0.070
P_{BS} (MW)	0.335	0.347	0.248	0.205	0.267	0.306	0.790
n_γ	1.477	1.504	1.257	0.823	1.664	1.756	1.725
Inc. Pairs/bc 10^6	0.414	0.366	0.259	0.084	0.350	0.612	0.637
H_D	1.80	1.78	1.70	1.56	1.79	1.65	1.74
$\mathcal{L}_{geom}$ 10^{34}	1.64	1.45	1.20	1.29	1.12	1.24	2.83
$\mathcal{L}$ 10^{34}	2.94	2.57	2.03	2.01	2.00	2.05	4.92

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**

GDE – Near Term Plan

- **Schedule**
  - **Begin define Configuration (Snowmass Aug 05)**
  - **Baseline Configuration Document by end of 2005**

  - **Put Baseline under Configuration Control (Jan 06)**
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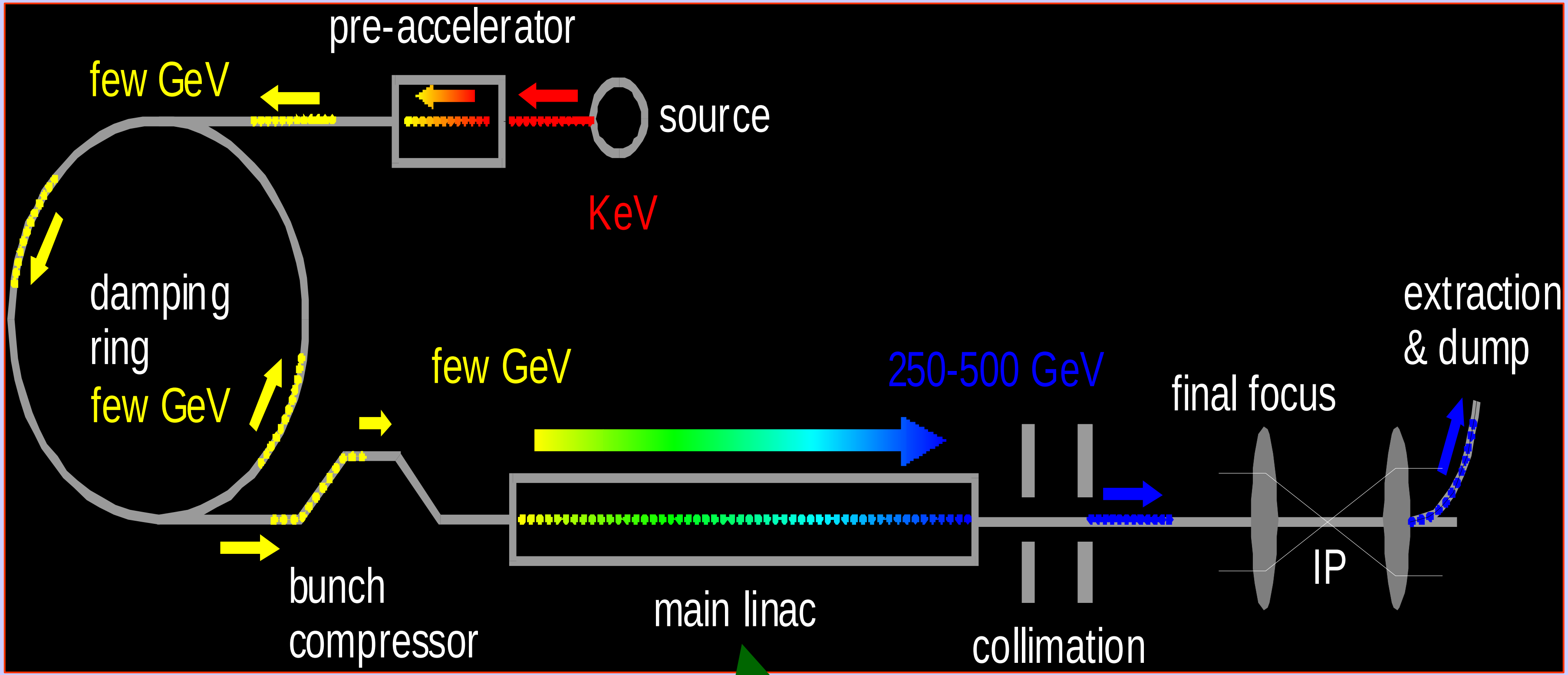
- **Three volumes -- 1) Reference Design Report; 2) Shorter glossy version for non-experts and policy makers ; 3) Detector Concept Report**

Starting Point for the GDE

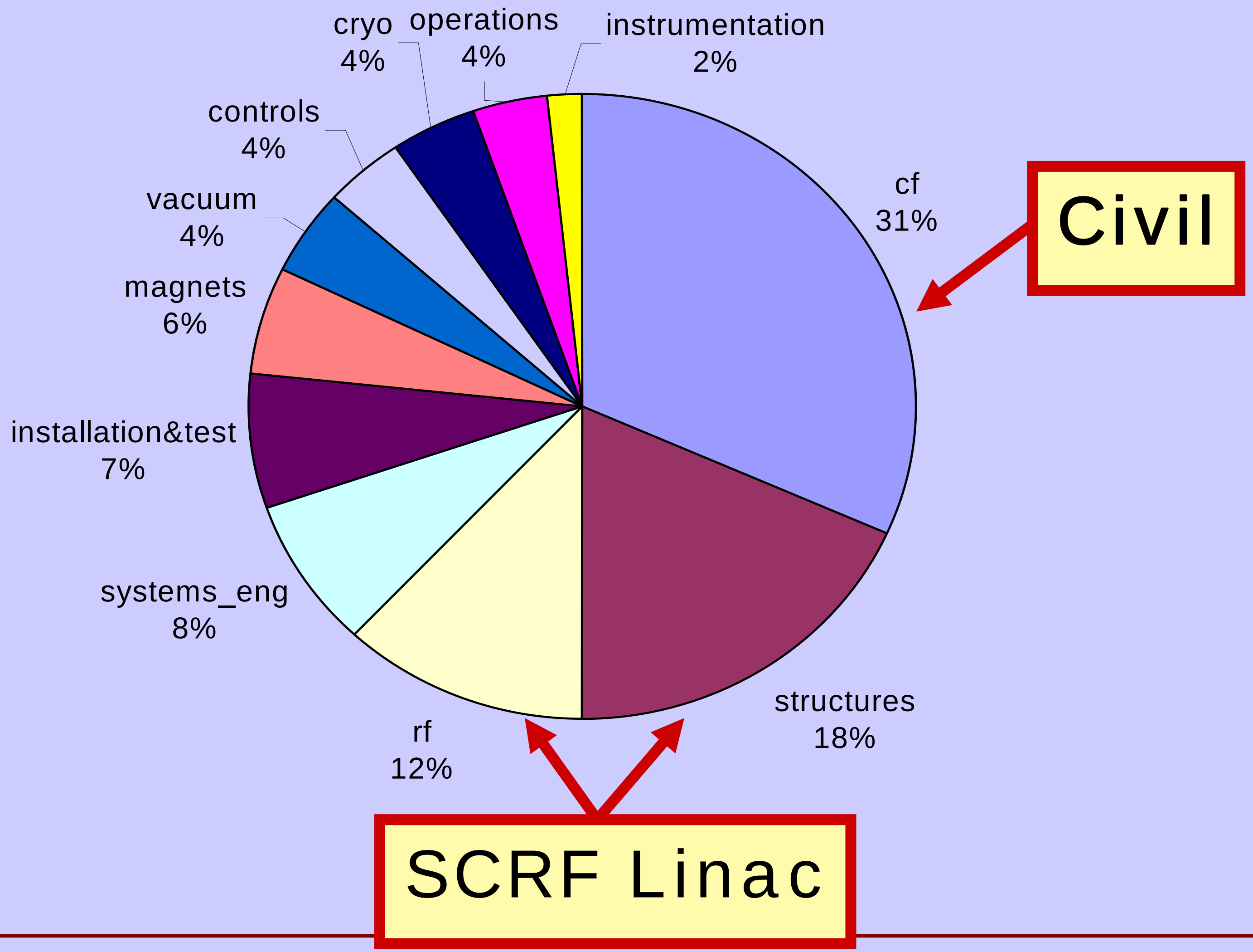


Superconducting RF Main Linac

Design Choices for Baseline

- **Design Alternatives**
  - **Gradient / Length (30MV/m?, 35MV/m? Higher?)**
  - **Tunnel (single? or double?)**
  - **Positron Souce (undulator? conventional?)**
  - **Damping ring (dogbone? small ring?)**
  - **Crossing angle (head-on, small angle, large angle)**
- **Define detailed configuration**
  - **RF layout**
  - **Lattice layout**
  - **Beam delivery system layout**
  - **Klystron / modulators**
  - **Cryomodule design**
- **Evolve these choices through "change control" process**

Cost Breakdown by Subsystem



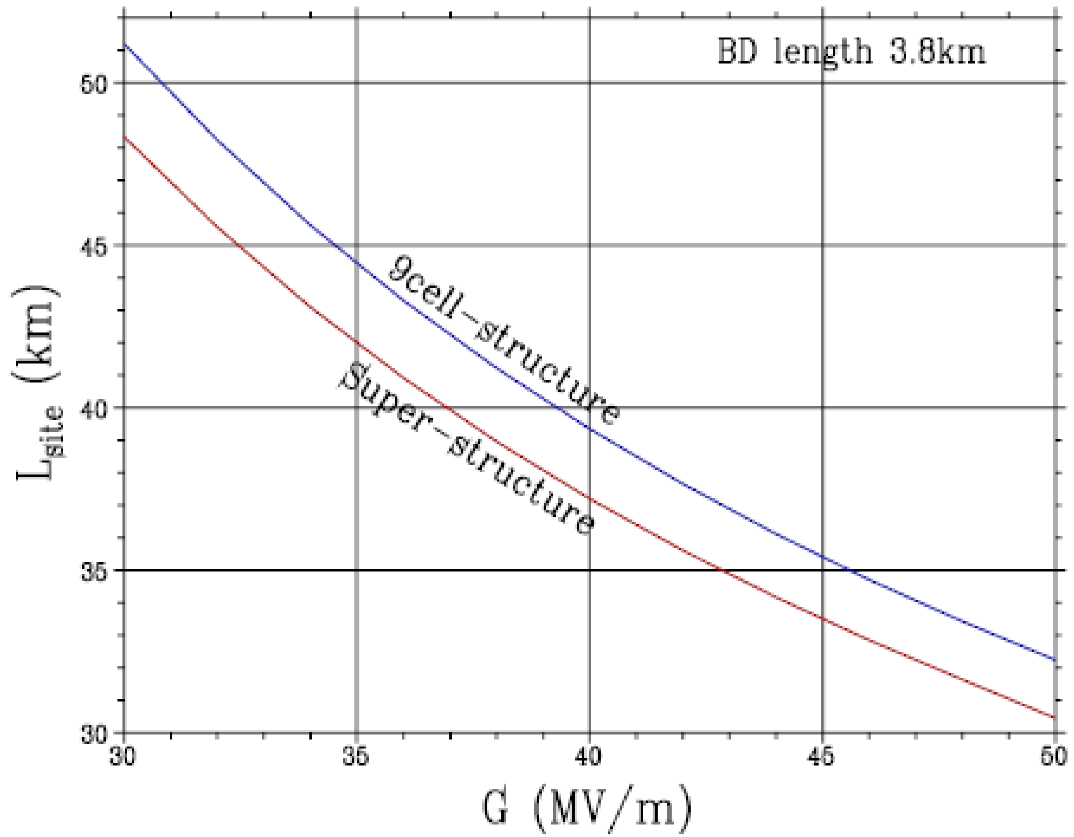
Gradient

- Must reach 1TeV
- Impact on the site length
- Cost minimum 35-40MV/m
- Conclusion of the WG5 in 1st WS at KEK

25MV/m in hand
35MV/m needs essential work
45MV/m for ILC upgrade

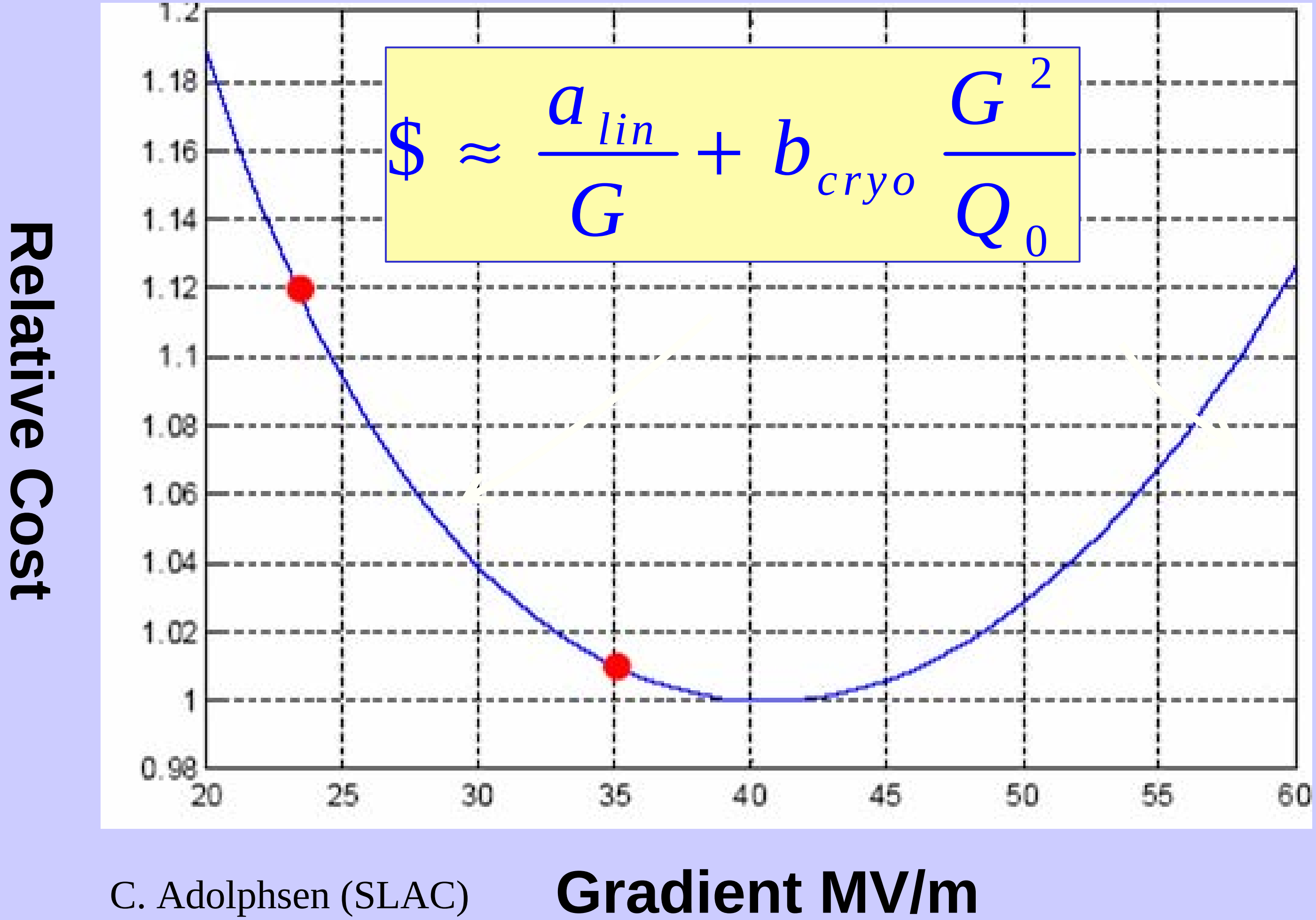
- LCWS2005 by N. Walker

30MV/m safe
35MV/m beaseline
40MV/m ambitius



Site length vs. Gradient for 1TeV

How Costs Scale with Gradient?



C. Adolphsen (SLAC)

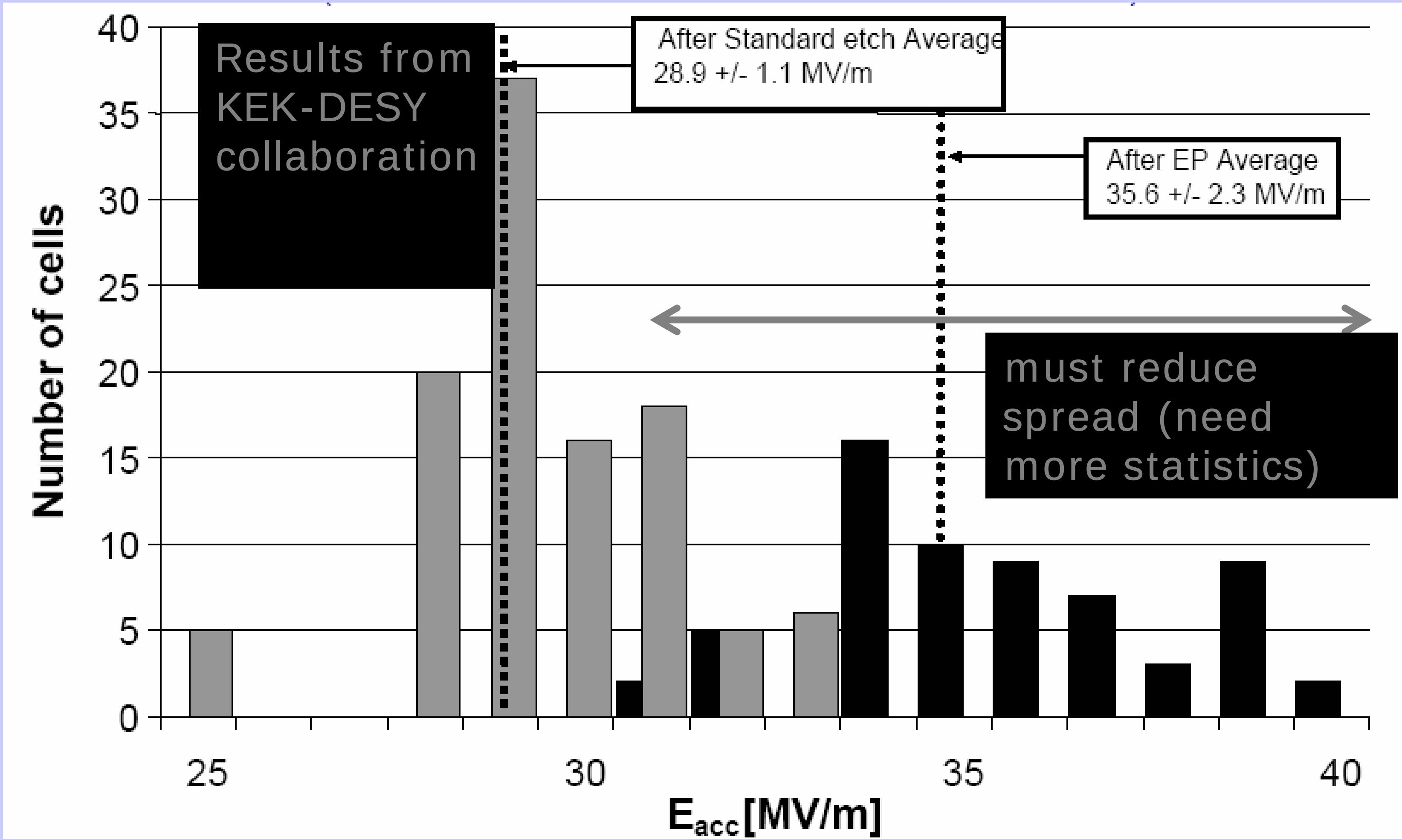
35MV/m is close to optimum

Japanese are still pushing for 40-45MV/m

30 MV/m would give safety margin

Gradient

single-cell measurements (in nine-cell cavities)

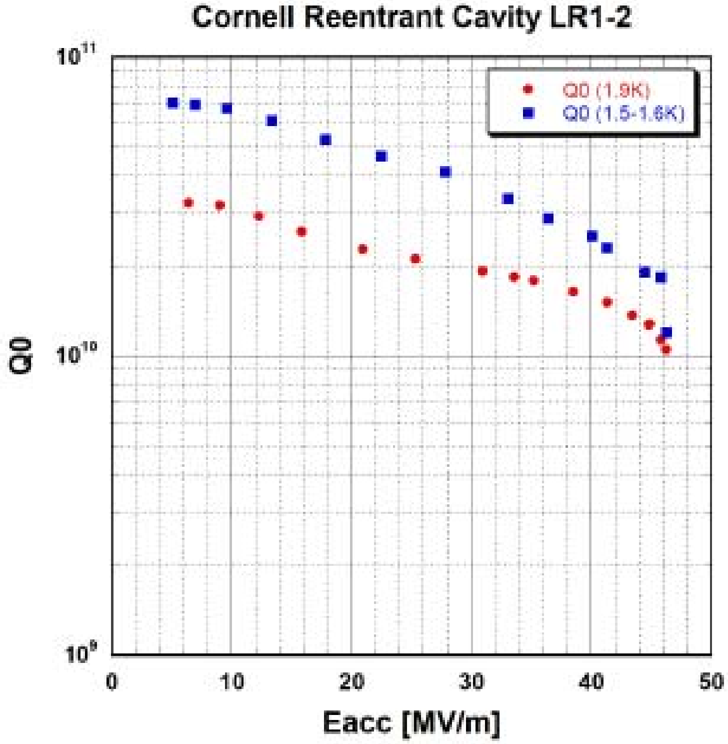


Experimental Status

single cell

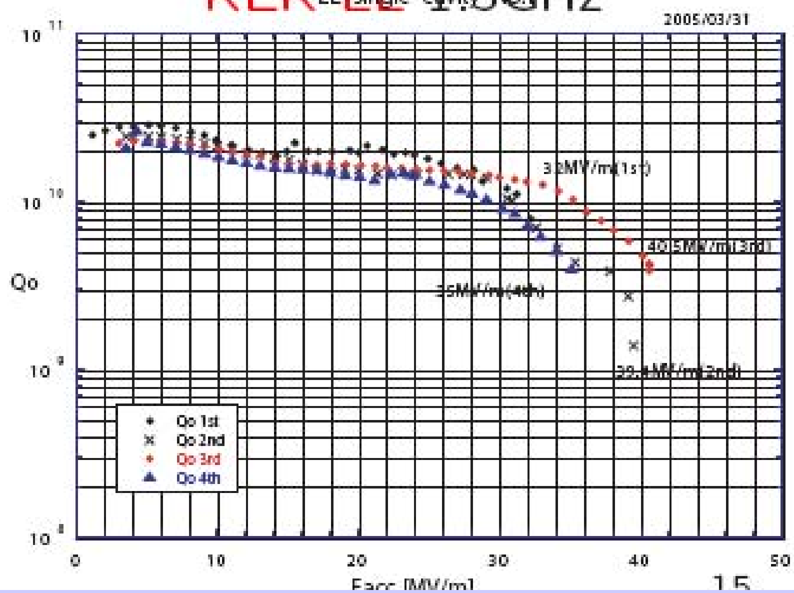
Cornell Reentrant 1.3GHz

47MV/m (pulsed) 1800 Oe



JLab Single Crystal 2.2GHz

KEK LL 1.3GHz



ILC Siting and Civil Construction

- **The design is intimately tied to the features of the site**
  - **1 tunnels or 2 tunnels?**
  - **Deep or shallow?**
  - **Laser straight linac or follow earth's curvature in segments?**

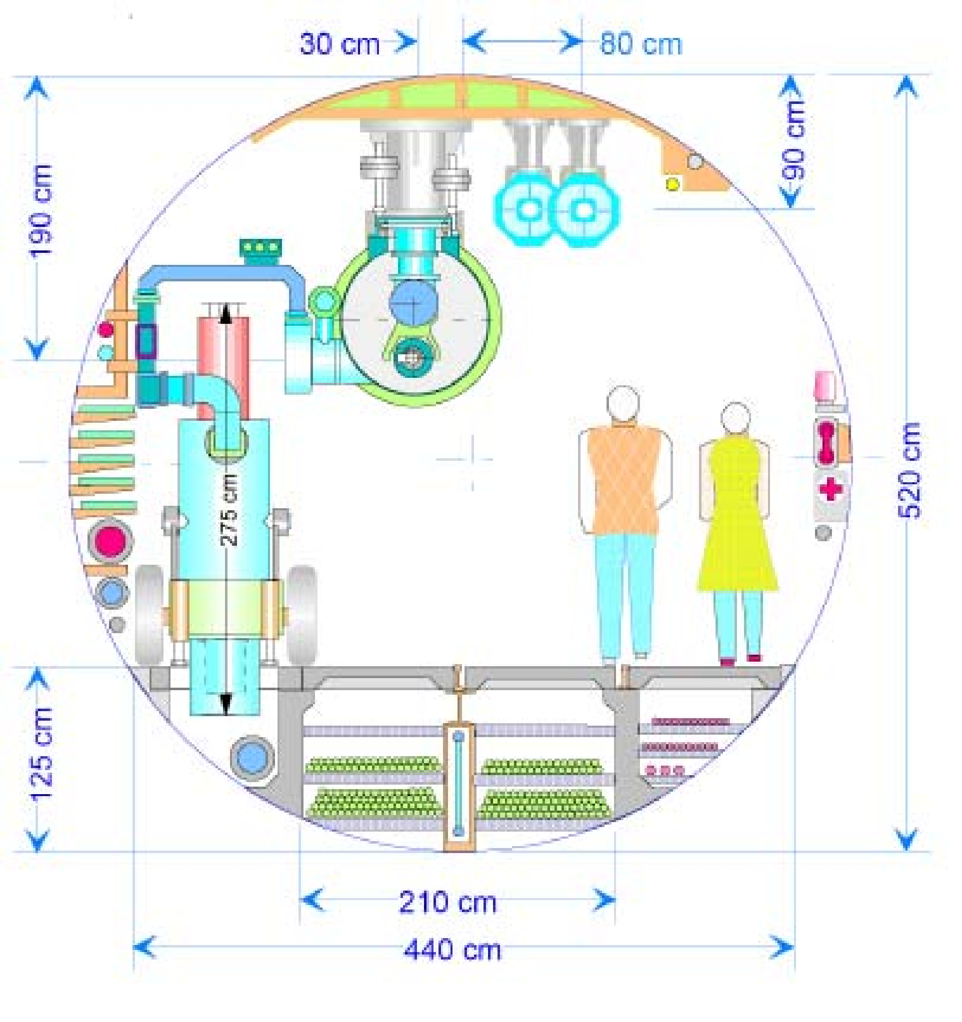
- **GDE ILC Design will be done to samples sites in the three regions**
  - **North American sample site will be near Fermilab**
  - **Japan and Europe are to determine sample sites by the end of 2005**

1 vs 2 Tunnels

- **Tunnel must contain**
  - Linac Cryomodule
  - RF system
  - Damping Ring Lines

- **Save maybe $0.5B**

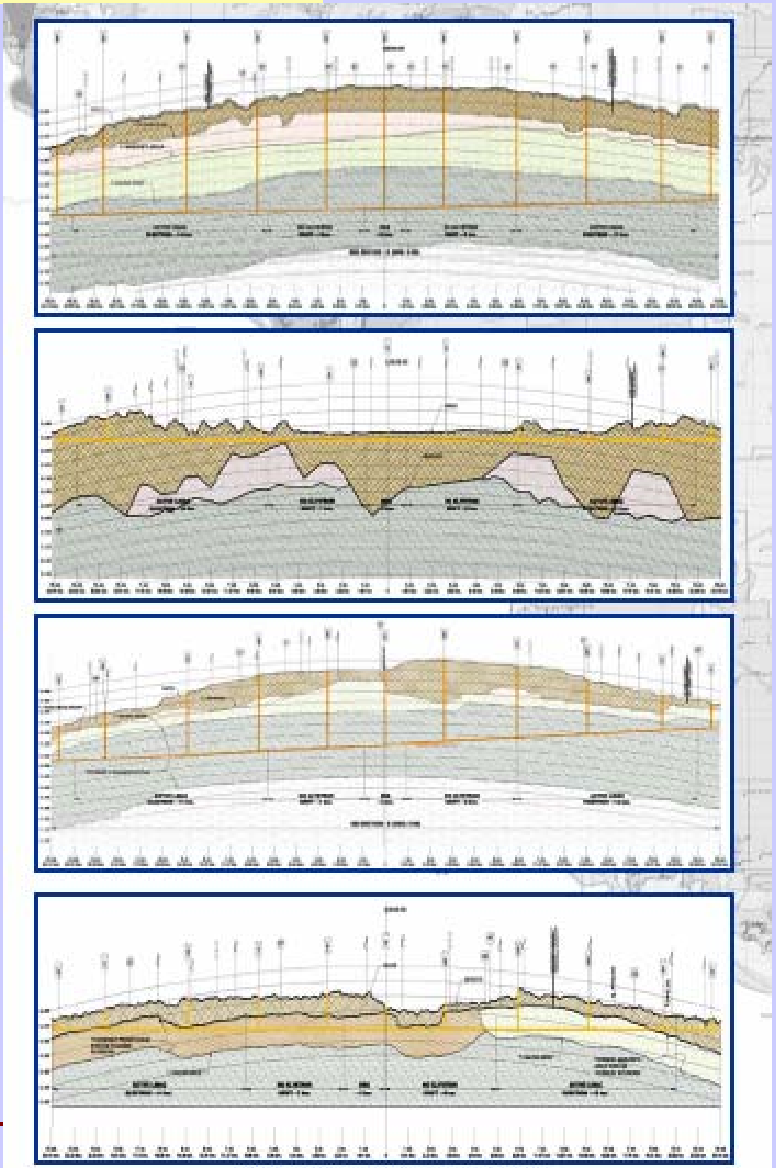
- **Issues**
  - Maintenance
  - Safety
  - Duty Cycle



ILC Civil Program

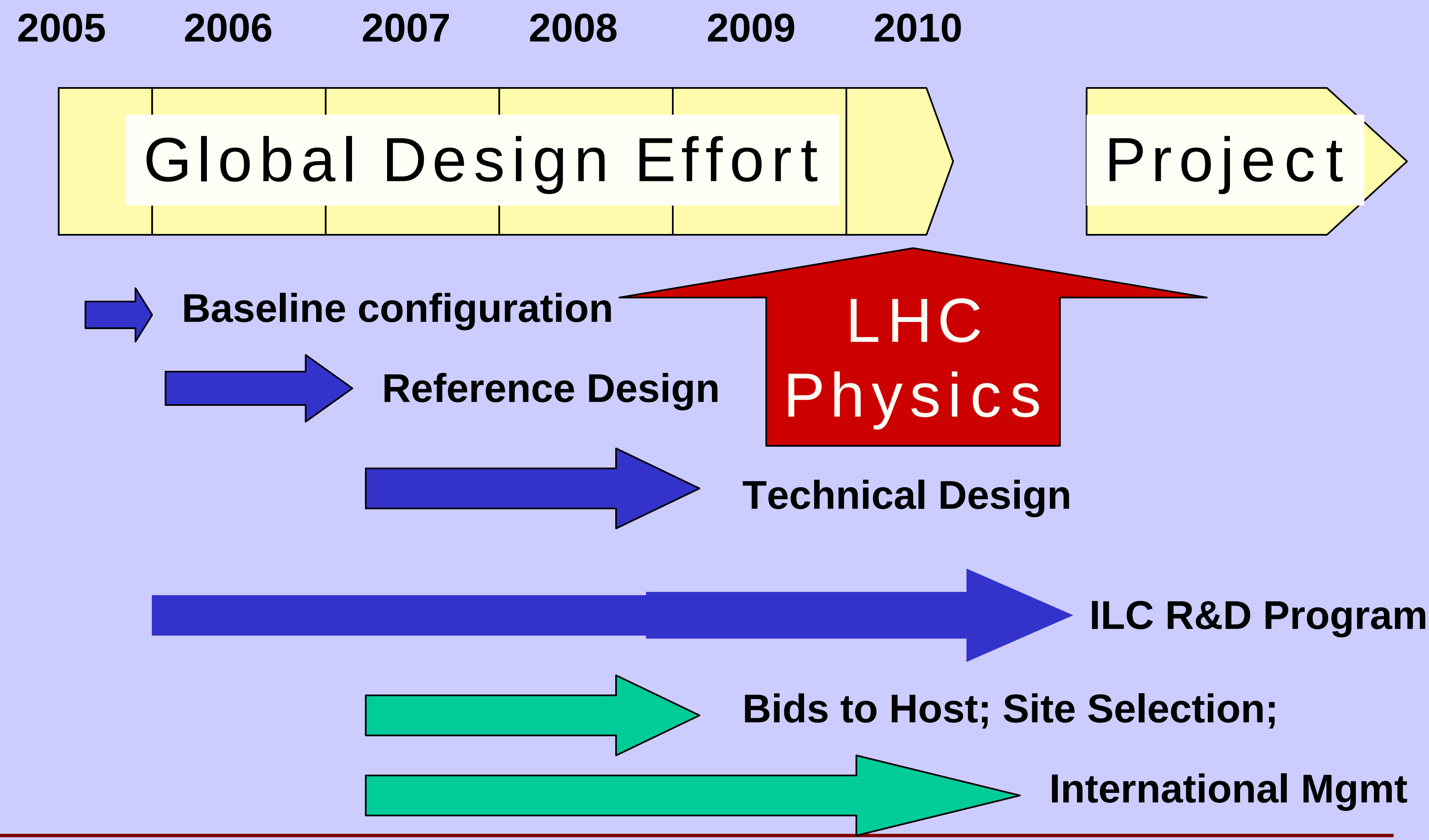
Civil engineers from all three regions working to develop methods of analyzing the siting issues and comparing sites.

The current effort is not intended to select a potential site, but rather to understand from the beginning how the features of sites will effect the design, performance and cost



Typical Site Profiles Under Study

The GDE Plan and Schedule

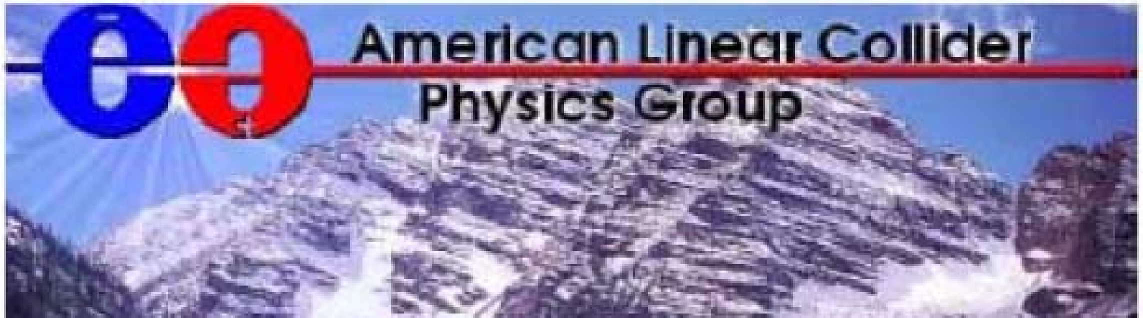


GDE Process and Meetings

- Snowmass (Aug 05) first meetings
- Frascati (Dec 7-10, 2005) (in conjunction with TESLA collaboration meeting)
- Bangalore, India (March 2006) (in conjunction with LCWS 2006)

- Our process and meetings will be open! Our website will post all progress, developments, issues and decisions. We invite community input and participation at each step.

Snowmass Workshop – Aug 2005



Speaking for the GDE, we look forward to a very exciting and productive workshop !!

Snowmass represents the kickoff of what we all hope will be a successful and truly international process to design and then build the next great particle accelerator !!!