GDE Overview

Barry Barish

PAC Review– Vancouver, Canada

9-May-09

Technical Reviews

- Accelerator Advisory Panel (Willis & Elsen)
  - **On-going reviews by assigned AAP members to particular systems (attend meetings, etc) Example result: Questions regarding plug compatibility have resulted in studies, report**
  - **Technical Review – first one 3.5 days at TILC09 in April. Internal + 4-5 external reviewers. Yearly through TDP phase with continuity. First review: Overall coverage + focus areas**
- ILCSC PAC Review:
  - **1.5 days (1 day GDE); higher level review and will use AAP review as input.**

PAC Oct08 Recommendations

- General
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  - **The flow of information on SC cavity processing and tests between labs is strongly encouraged. The same is true for information from industry, although the PAC acknowledges the difficulties that may arise in this case.**
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CLIC / ILC Collaboration

- Working Groups with joint leadership

- Accelerator Tech Areas
- Physics / Detectors
- Costing

- First progress reported last fall

CLIC / ILC Joint Statements

27 October 2008

Purpose of these statements:

The CLIC and ILC Collaborations agree to work together, within the framework of the CLIC / ILC Collaboration, to outline comparative statements to be used in presenting their respective projects. The Collaboration members agree to limit statements made about each other's projects to specifically agreed upon statements such as those listed below:

• Project design

The CLIC and ILC projects both plan to release design documents in the coming years. The CLIC Conceptual Design Report is to be published in 2010. If the CLIC technology is demonstrated to be feasible, a CLIC Technical Design will then be launched for publication in a CLIC TDR by 2015. The ILC TDR will be published in 2012. The design reports are intended to summarize the R&D and project planning at that time and will serve as indicators of project readiness. Both TDRs are intended to be submitted to governments and associated funding agencies in order to seek project approval.

• Test facilities and system tests

The CLIC and ILC projects both have test facilities either in operation or under construction for the purpose of demonstrating the performance of key technical components or to allow system engineering and industrialization. For each project, R&D priorities and schedules have been defined and it is anticipated that milestones and progress will be reviewed and reported on by members of the community. The XFEL project, with the same technical basis as the ILC, although at a lower accelerating gradient, and 7% of the energy of one of the ILC linacs, is a large-scale system test and demonstration of the industrialization of the ILC linac technology. The CERN- based CTF3 project is a demonstration of the CLIC two beam technology, although at a lower beam power.

• Technology maturity and risk

The collaborations agree that the ILC technology is presently more mature and less risky than that of CLIC. There are plans to demonstrate, by 2010, the feasibility of CLIC technology and to reduce the associated risk in the future. The ILC collaboration will focus on consolidation of the technology for global mass-production. Both collaborations consider it essential to continue to develop both technologies for the foreseeable future.

• Costing

Project planners from the CLIC and ILC projects are developing common methodologies and tools with the intention of enabling the development of similarly-structured project planning and costing documents for each of the two projects. The two collaborations agree to make no public statements about the comparative cost numbers of the two machines until these project planning and costing documents are complete.

Barry C. Barish	***J-P. Delahaye***
ILC-GDE Director	CLIC Study Leader

Context

- **CLIC – ILC Collaboration has two basic purposes:**
  1. **allow a more efficient use of resources, especially engineers**
     - CFS / CES
     - Beamline components (magnets, instrumentation…)
  2. **promote communication between the two project teams.**
     - Comparative discussions and presentations will occur
     - Good understanding of each other's technical issues is necessary
     - Communication network – at several levels – supports it
- **seven working groups which are led by conveners from both projects**

Collaboration Working Groups

	CLIC	ILC
Physics & Detectors	**L.Linssen, D.Schlatter**	**F.Richard, S.Yamada**
Beam Delivery System (BDS) & Machine Detector Interface (MDI)	**D.Schulte, R.Tomas Garcia E.Tsesmelis**	**B.Parker, A.Seryi**
Civil Engineering & Conventional Facilities	**C.Hauviller, J.Osborne.**	**J.Osborne, V.Kuchler**
Positron Generation (new 11/08)	**L.Rinolfi**	**J.Clarke**
Damping Rings (new 11/08)	**Y.Papaphilipou**	**M.Palmer**
Beam Dynamics	**D.Schulte**	**A.Latina, K.Kubo, N.Walker**
Cost & Schedule	**H.Braun, K.Foraz, P. LeBrun**	**J.Carwardine, P.Garbincius, T.Shidara**

our common plans - *11/08*:

- √ CLIC-ILC Cost & Schedule Working Group WEBEX Meetings
  1400 GMT - 2nd Thursday of each month
- √ Keep work towards cost estimate mutually transparent
- √ Profit by synergies
- √ Understand and communicate unavoidable differences in the methodologies
  used for the two projects
- √ Construction & installation schedules for CLIC & ILC w same methodology – 6/09
- Common ILC/CLIC notes (for mid '09)
  - Tunnel safety underground compliance
    defer to: Fabio Corsenego - ILC-CFS and CLIC-CES groups
  - Standardization methods to estimate cost of warm magnets including cabling and power supplies – Braun & Garbincius gathering materials, but international magnet fabrication experts ***– are just not available! - defer***
  - Description of cost risk assessment – Lebrun, Riddone, Lehner, Garbincius
    reviewed other applications, started outlining this mgt – outline soon!

CLIC/ILC Costing Garbincius summary slide at TILC09

CLIC / ILC Collaboration

- The next step to making the most of the growing joint ILC / CLIC collaboration will be pursued at CERN next month.
  - **We will hold a one day face-to-face meeting of our GDE Executive Committee at CERN**
  - **We will have a joint meeting with between the CLIC Extended Steering Committee and the GDE Executive Committee the second day. Rolf Heuer will participate.**
  - **Our ILC communicators will meet at CERN and explore joint communications.**

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The Project Managment

- **GDE has been reorganized around a GDE Project Management Office to reach this goal**
- **Project Managers: Marc Ross, Nick Walker and Akira Yamamoto**
  - **Central management being given the authority to set priorities and coordinate the work**
  - **Resources for the technical design and associated R&D are limited, but program goals have been keyed to our best estimate of available resources.**
  - **Anticipate LHC results by about 2012 when we plan to be ready to pursue a robust proposal to our governments**
  - **Investments are needed toward Industrialization and siting**

Project Management Plan

ILC Project Management Plan for the Engineering Design (ED) Phase
International Linear Collider Project Management Team
M Ross, N Walker, A Yamamoto, Project Managers

Purpose

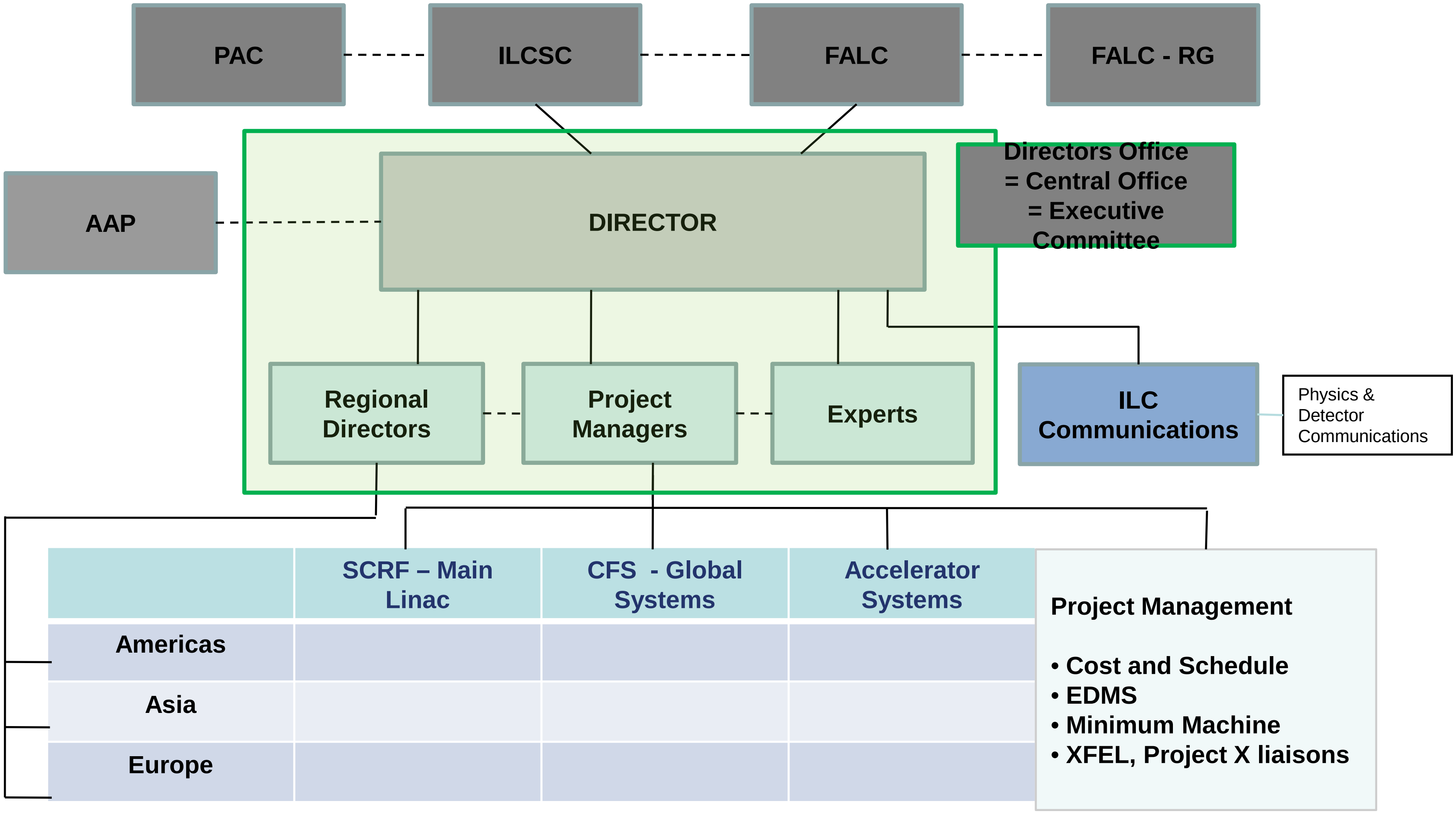
This document describes the organization and processes that will be used to complete the Engineering Design Phase of the ILC Global Design Effort.

As the project progresses, the Project Management Plan will be periodically reviewed, and subsequently revised as needed.

Release 2.0 dated 15 Oct 2007.

http://ilcdoc.linearcollider.org/record/11980

GDE Organization Chart



AAP on Project Planning

- "Maintaining project-style control of the work is hampered by the distributed nature of the personnel, the lack of direct control of the budget, the lack of control of the assignment and utilization of personnel and the challenge to profit from facilities with objectives that only partially overlap with those of the ILC."

- Nevertheless, they recommend:
  - *"The AAP suggests that the following linked strategies would be helpful in sharpening the focus of the GDE effort: a) reserve, and protect, more time for the GDE Director and the troika to formulate and agree upon project objectives b) actively and visibly (to the GDE team at large) rebalance the objectives so that they are more focused on the milestone-related goals and less emphasize an ever broadening R&D program c) take active steps to create, and support broad and coherent ownership of the core goals."*

AAP Report – see report & Elsen talk

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R&D Plan - Technical Design Phase

ILC Research and Development Plan for the Technical Design Phase

Release 3

February 2009

ILC Global Design Effort

Director: Barry Barish

Prepared by the Technical Design Phase Project Management

Project Managers: Marc Ross, Nick Walker, Akira Yamamoto

- “Living Document”
- A 60 page document with details of all R&D programs, schedules and resources.
- **New: Release 3**
- Technical Design Phase
  - **Phase 1 2010 (critical R&D demonstrations; new baseline**
  - **Phase 2 2012 (technical design and implementation plan –> construction proposal ready**

Major Milestones for TDP 1

SCRF

- **High Gradient R&D - globally coordinated program to demonstrate gradient by 2010 with 50%yield;**

ATF-2 at KEK

- **Demonstrate Fast Kicker performance and Final Focus Design**

Electron Cloud Mitigation – (CesrTA)

- **Electron Cloud tests at Cornell to establish mitigation and verify one damping ring is sufficient.**

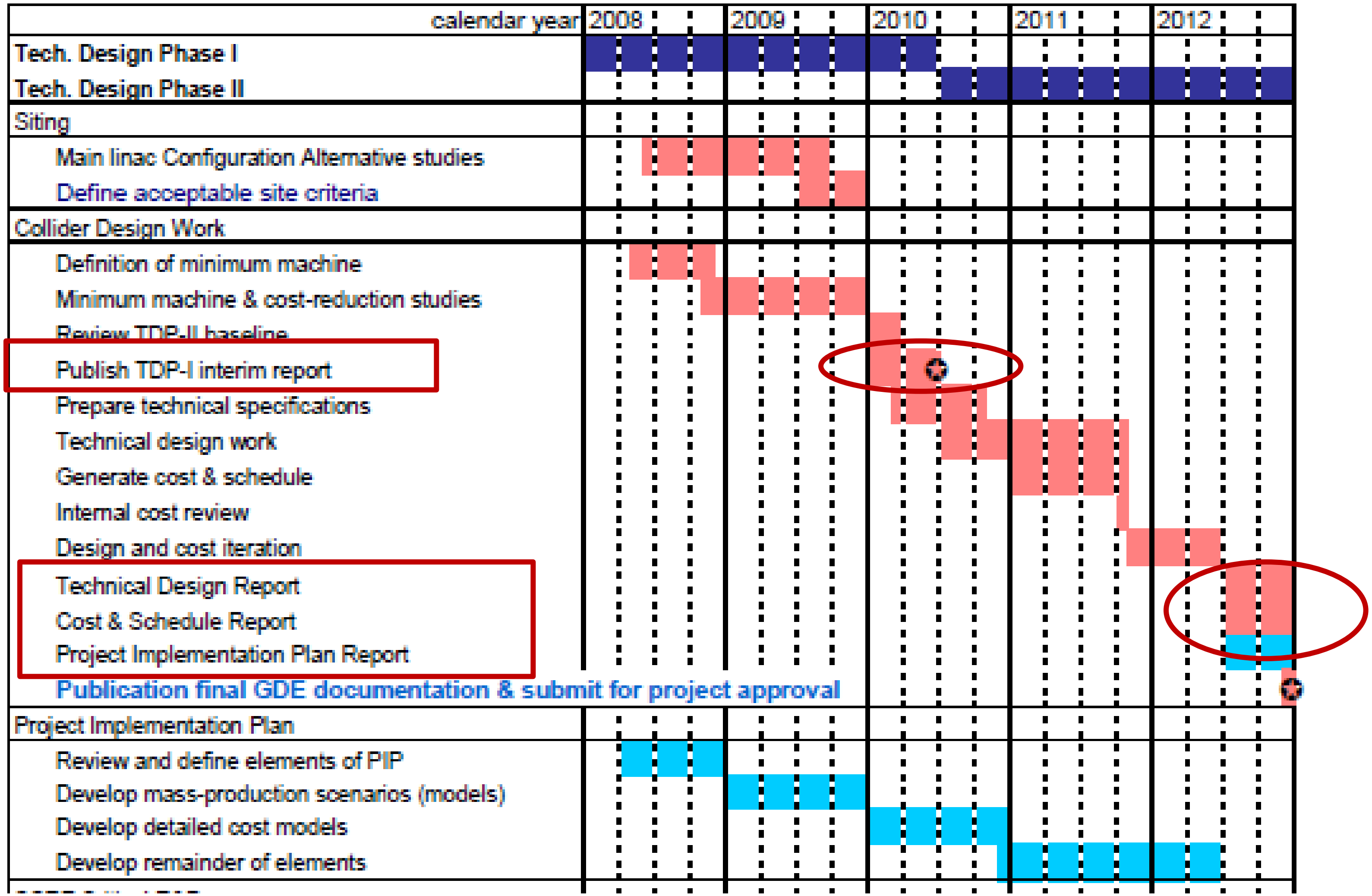
Minimum Machine Studies (Cost/Performance)

- **Studies of possible cost reduction designs and strategies for consideration in a re-baseline in 2010**

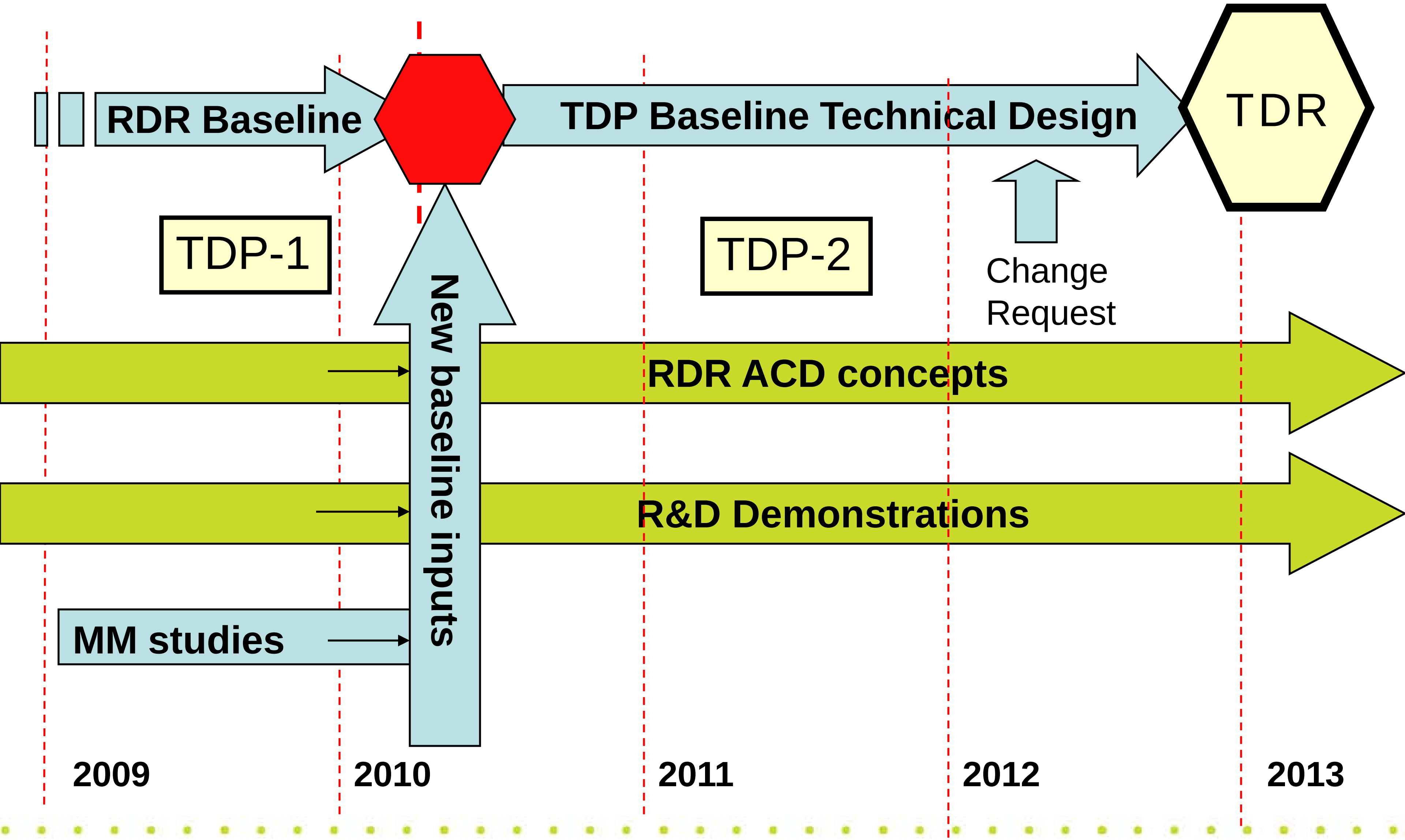
R&D Test Facilities Deliverables

Test Facility	Deliverable	Date
Optics and stabilisation demonstrations:		
ATF	Generation of 1 pm-rad low emittance beam	2009
ATF-2	Demonstration of compact Final Focus optics (design demagnification, resulting in a nominal 35 nm beam size at focal point).	2010
	Demonstration of prototype SC and PM final doublet magnets	2012
	Stabilisation of 35 nm beam over various time scales.	2012
Linac high-gradient operation and system demonstrations:		
TTF/FLASH	Full 9 mA, 1 GeV, high-repetition rate operation	2009
STF & ILCTA-NML	Cavity-string test within one cryomodule (S1 and S1-global)	2010
	Cryomodule-string test with one RF Unit with beam (S2)	2012
Electron cloud mitigation studies:		
CESR-TA	Re-configuration (re-build) of CESR as low-emittance e-cloud test facility. First measurements of e-cloud build-up using instrumented sections in dipoles and drifts sections (large emittance).	2008
	Achieve lower emittance beams. Measurements of e-cloud build up in wiggler chambers.	2009
	Characterisation of e-cloud build-up and instability thresholds as a function of low vertical emittance ($\leq$20 pm)	2010

Design / Cost Reduction / PIP



Technical Design Phase <u>and Beyond</u>



Beyond 2012 ?

- **The AAP points to uncertainties beyond 2012 in their conclusions:**
  - "Some aspects of the R&D for the ILC will have to continue beyond 2012."
  - "The milestone 2012 is however timely placed. The LHC will be providing operating experience of a large facility and with some luck the first physics discoveries will emerge."
  - "The HEP community is thus well prepared for the decision for the next facility. In a sense the construction of the ILC seems the natural evolution of that process, in which case the efforts for the ILC have to be ramped up without delay."
  - "Nature may be less kind or science policy makers not ready for a decision on the next big HEP project. In this case the large community must be engaged to facilitate the decision for the construction of the next HEP project."
- **We need to prepare for uncertainties in the path to the ILC after 2012**

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ILC R&D Facilities and Program

- The ILC facility based R&D program, integrated into R&D programs at our large collaborating laboratories have been the “engine” that has enabled us to make substantial progress, even during difficult times.
- Highlights:

  SCRF

  - **Beam tests at FLASH (DESY); preparations for STF and ILCTA**

  ATF-2 at KEK

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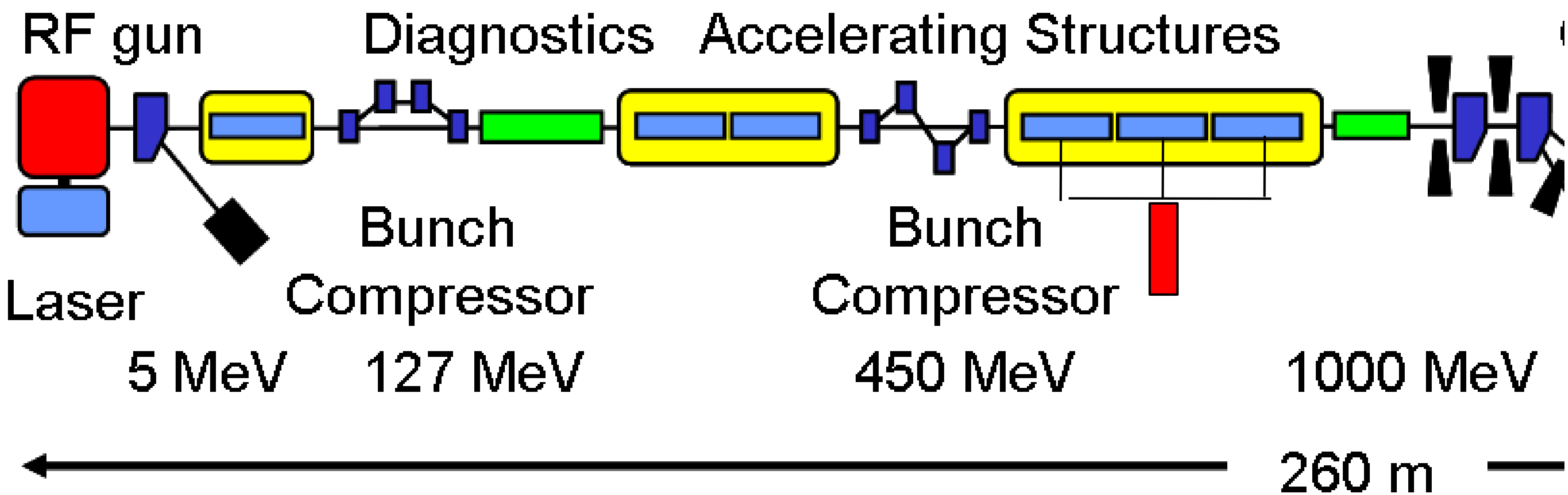
Beam Tests

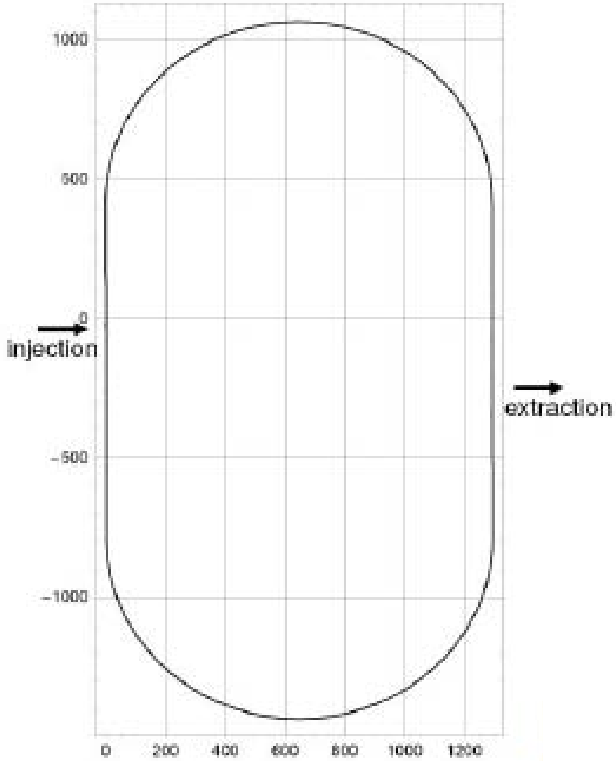


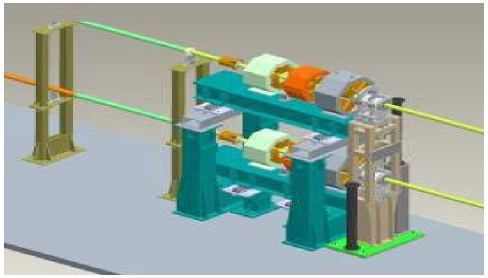
		XFEL X-Ray Free-Electron Laser	ilc	FLASH design	FLASH experiment
Bunch charge	nC	1	3.2	1	3
# bunches		3250*	2625	7200*	2400
Pulse length	μs	650	970	800	800
Current	mA	5	9	9	9

Damping Ring R&D

- DR has a flexible race track design
  - 6.4 km Circumference with >1 km straights, which contain, RF, Wigglers, Chicanes, Injection/ Extraction Systems

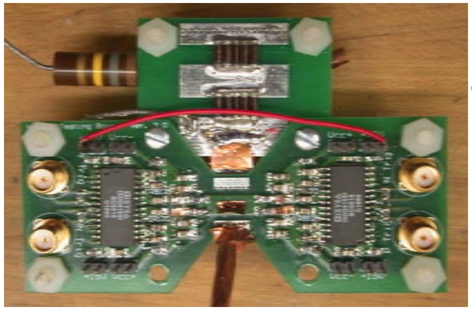
- There are two critical components which require a successful demonstration in TDP1
  - Fast Inj/Ext Kickers
  - Suppression of e- Cloud in the e+ ring



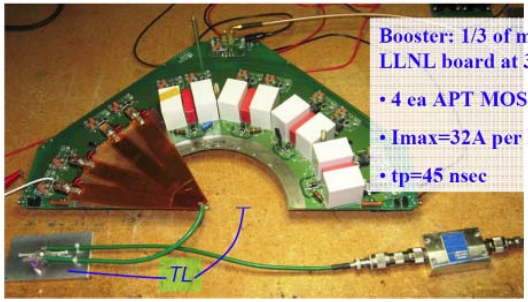


Fast Kicker R&D Program

- There are presently four strands to the R&D program:
  - **SLAC/LLNL**: Development of fast high-power pulsers based on MOSFET technology.
  - **SLAC/DTI:** Development of fast high-power pulsers based on DSRD (drift step recovery diode) technology.
  - **INFN-LNF:** Tests of fast kickers in DAΦNE.
  - **KEK:** Tests of fast kickers in the ATF.

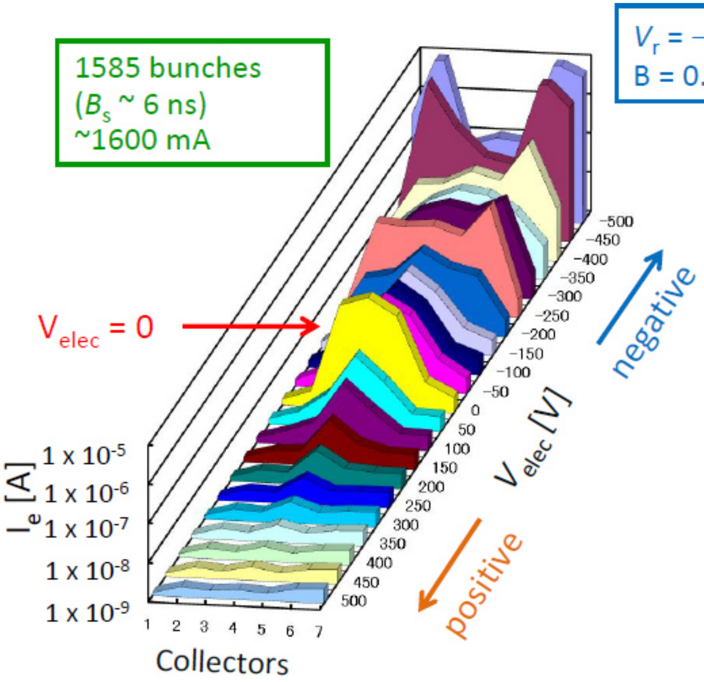


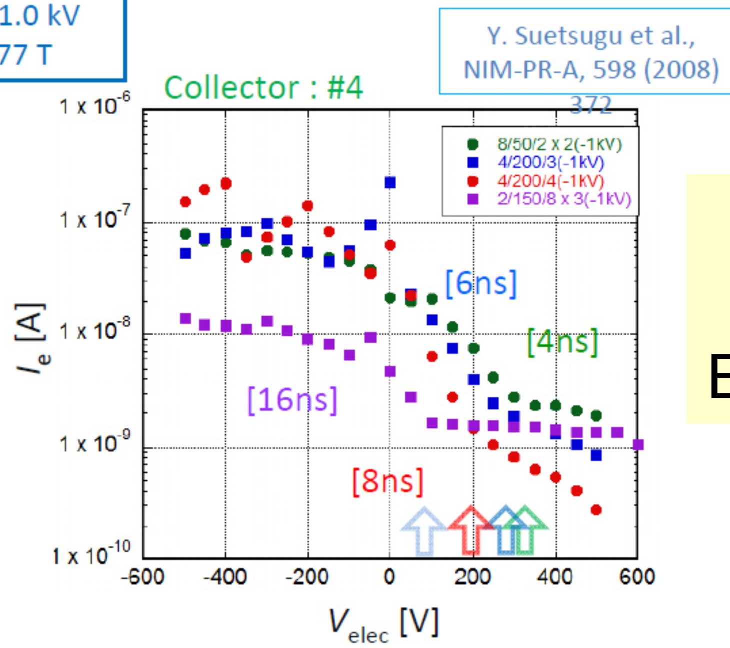
Tests of MOSFET-based pulser show promising performance.



Tests of DSRD-based pulser using board based on LLNL design (for MOSFET inductive adder). Performance is limited by board design and components.

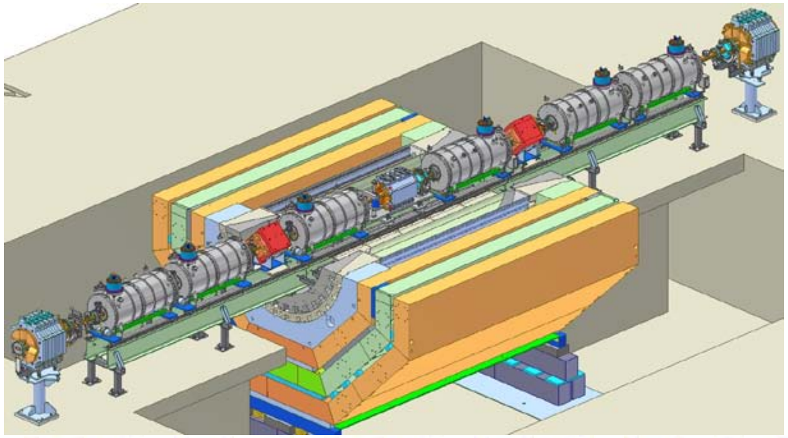
Electron Cloud R&D





KEK-B Clearing Electrodes

CESR reconfigured to have 12 damping wigglers located in zero dispersion regions for ultra low emittance operation.



ATF / ATF2 R&D Program and Goals

- Beam delivery system studies
  - **Demonstrate ~ 50 nm beam spot by 2010**
  - **Stabilize final focus by 2012**
- Broad international collaboration (mini-ILC) for equipment, commissioning and R&D program

ATF2 Beam Line vacuum pipe connected in October

Commissioning underway

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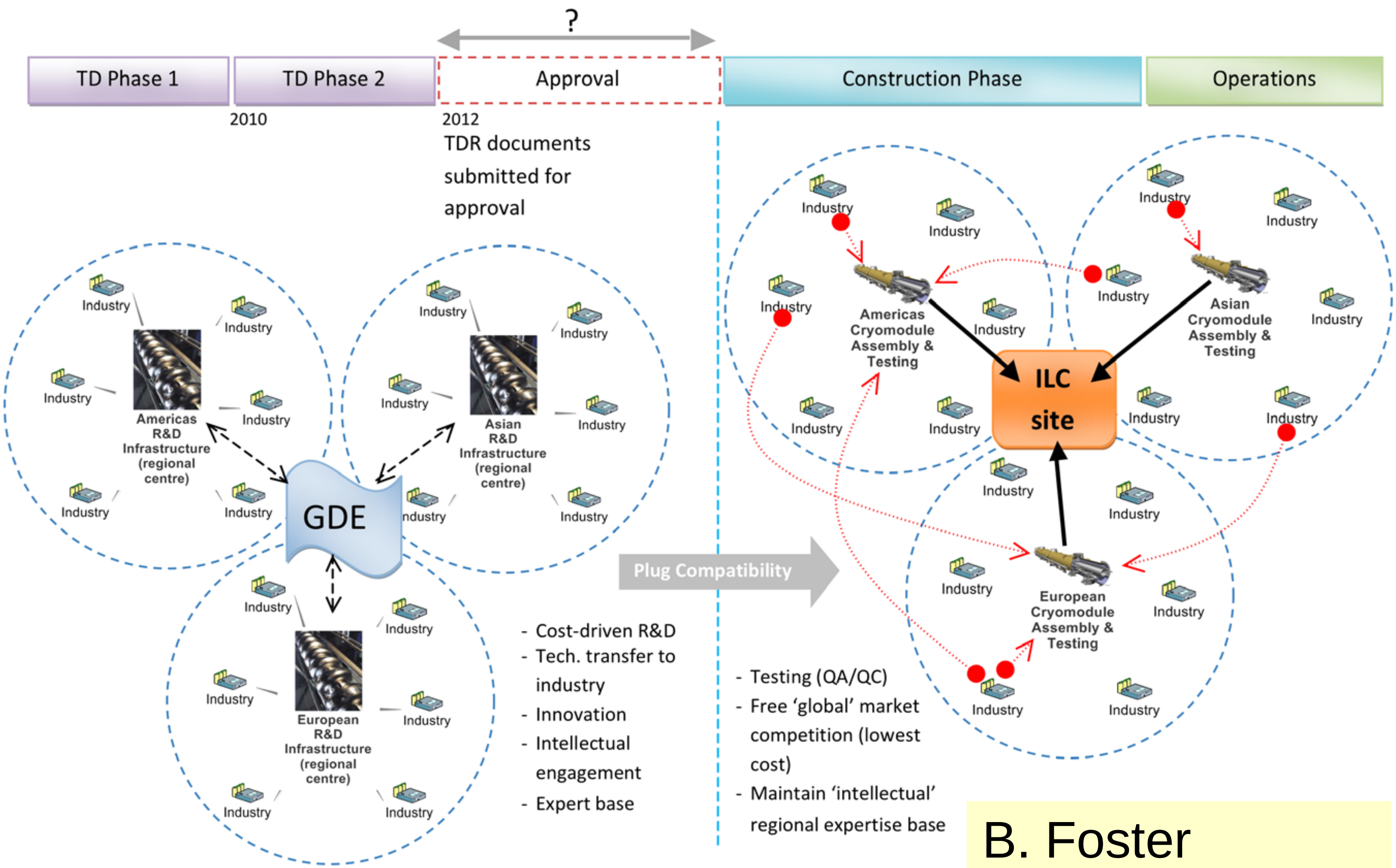
The Role of Plug Compatibility



- Cost-driven R&D
- Tech. transfer to industry
- Innovation
- Intellectual engagement
- Expert base

- Testing (QA/QC)
- Free 'global' market competition (lowest cost)
- Maintain 'intellectual' regional expertise base

B. Foster
Governance Talk

Cryomodule Assembly

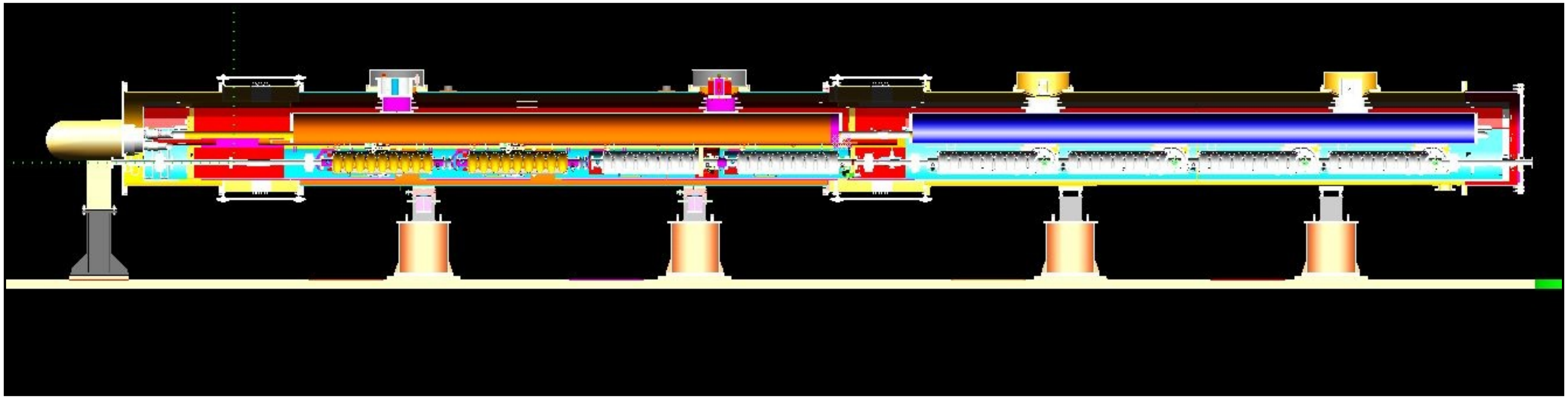
Plug Compatible Approach

Cryomodule costs (RDR)	fraction	sum
Cavity Fabrication	36%	36%
Power Couplers	10%	46%
Helium Vessel Fabrication	8%	54%
Magnetic Package (Quad)	7%	61%
Tuners	7%	68%
Assembly, Testing, Transport	5%	72%

(Next 7 items – to 1% level (22%)– Vacuum vessel, shields, interconnect, processing, dressing, pipes, supports, instrumentation)

S1 Global Tests

- Cavity integration and the String Test globally organized with tests to be done at KEK STF facility
  - **2 cavities from DESY and Fermilab**
  - **4 cavities from KEK**
  - **Each half-cryomoducle from INFN and KEK**



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Global R&D Plan
Consensus in SCRF-TA

Calender Year	2007	2008	2009	2010	2011	2012
Technical Design Phase	TDP-1				TDP-2	
Cavity Gradient R&D to reach 35 MV/m		Process Yield > 50%			Production Yield >90%	
Cavity-string test: with 1 cryomodule			Global collab. <31.5 MV/m>			
System Test with beam 1 RF-unit (3-modulce)		FLASH (DESY)			STF2 (KEK) NML (FNAL)	→ ?

Akira Talk

Beam Tests: FLASH (Walker)

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The ILC SCRF Cavity

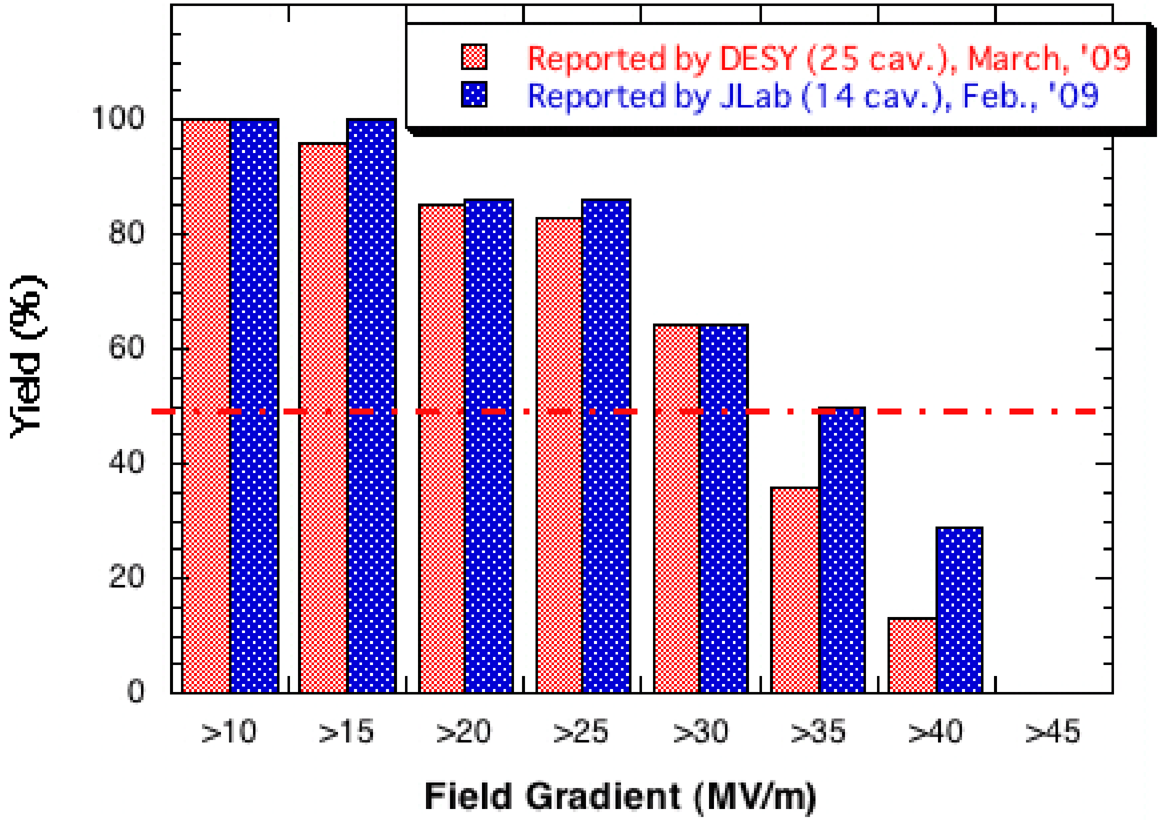
Figure 1.2-1: A TESLA nine-cell 1.3 GHz superconducting niobium cavity.

- Achieve high gradient (35MV/m); develop multiple vendors; make cost effective, etc

- Focus is on high gradient; production yields; cryogenic losses; radiation; system performance

See Akira Talk – Gradient Status

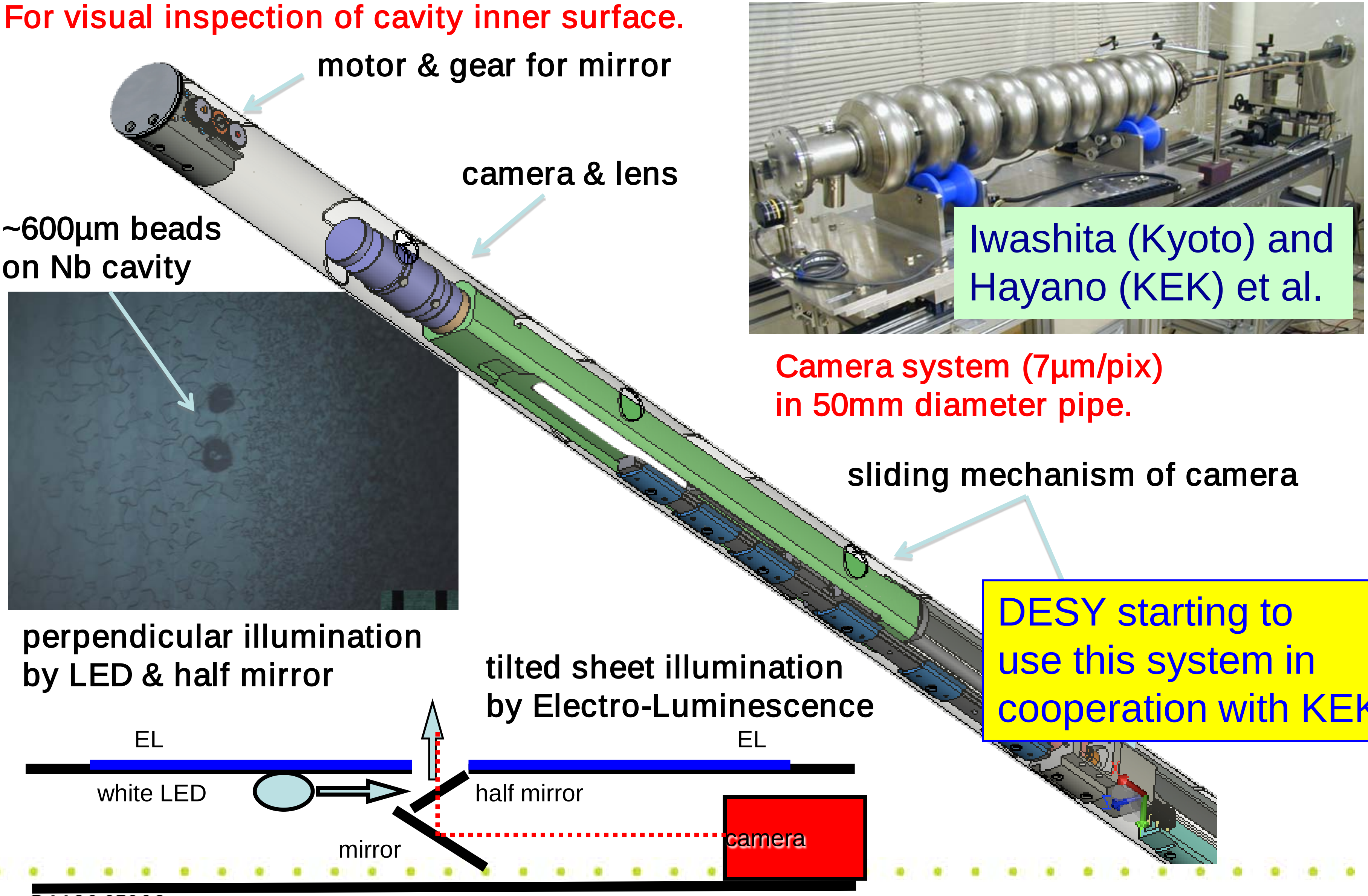
Cavity Gradient



- Akira – progress and plans toward establishing cavity gradient for TDR

Diagnostics -- Optical Inspection

For visual inspection of cavity inner surface.



~600µm beads
on Nb cavity

Camera system (7µm/pix)
in 50mm diameter pipe.

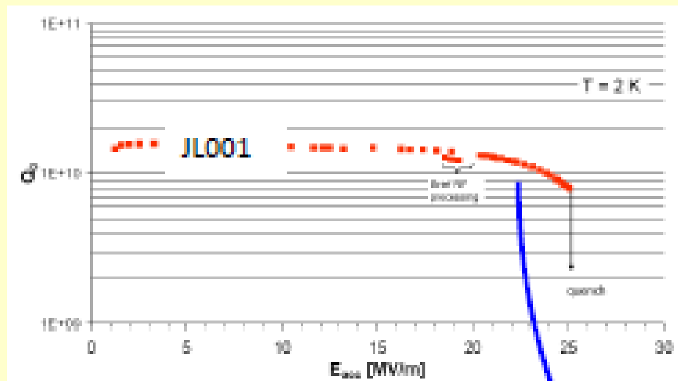
DESY starting to use this system in cooperation with KEK

perpendicular illumination
by LED & half mirror

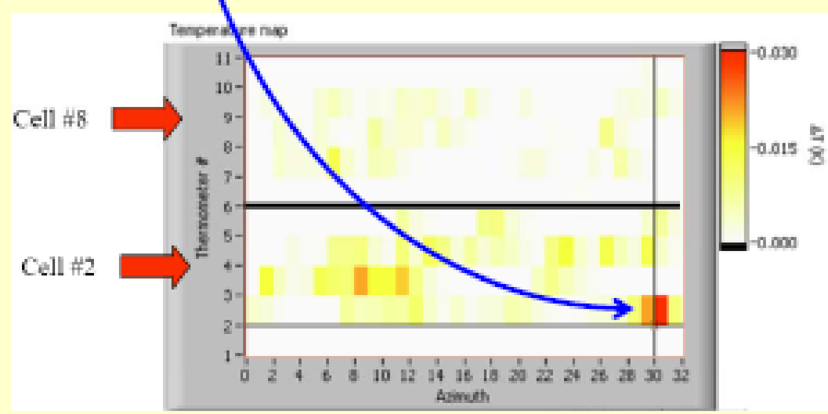
tilted sheet illumination
by Electro-Luminescence

Thermometry for Local Hotspots

A 2-cell thermometry system for ILC 9-cell cavity was designed, built and commissioned at JLab to study defects

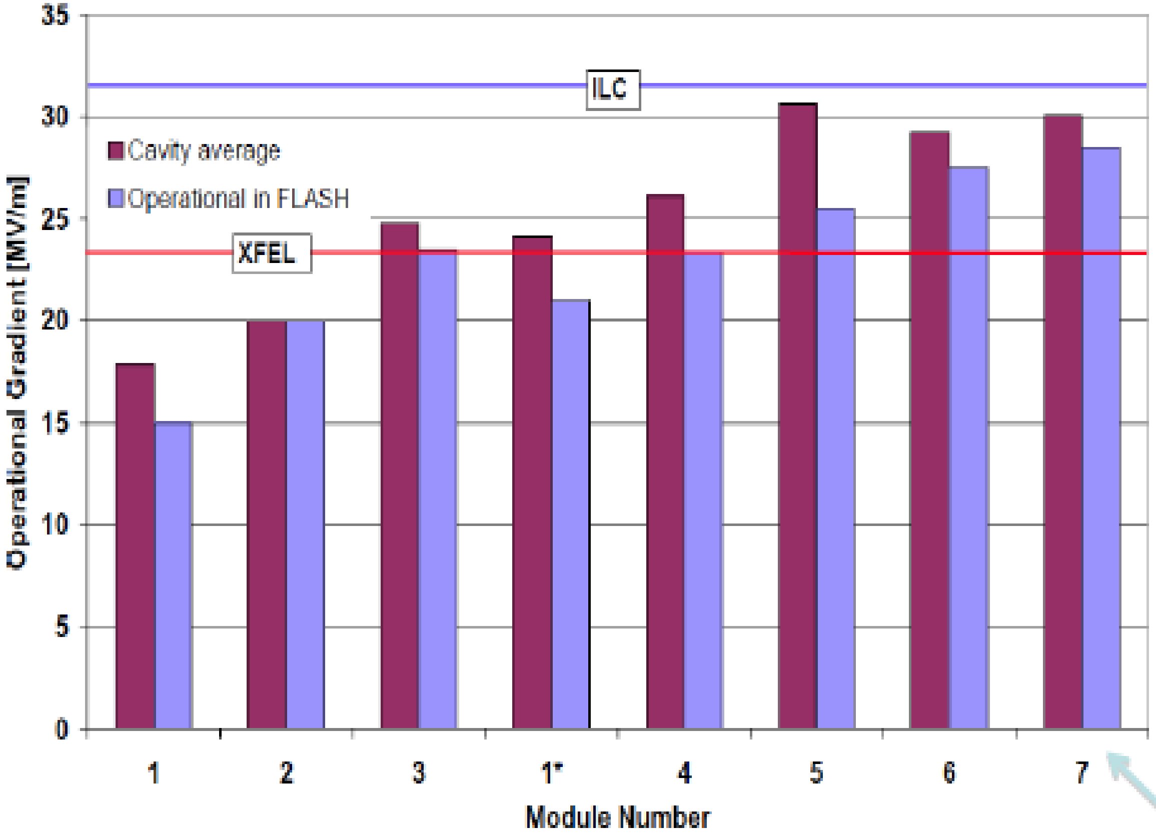


"Hot-spots" were detected near the equator weld of one of the cells, causing the Q-drop



JLab

Cryomodule Gradient Progress



ILC operation :

- <31.5> MV/m spec
- (27 MV/m achieved at DESY/FLASH)
- (29 MV/m achieved DESY test stand)

•20 % improvement required for ILC

PAC Oct08 Recommendations

- Accelerator (continued)
  - **The PAC is very positive about the GDE concept of plug compatibility, especially for SC cavities. It notes that GDE will need to monitor the large flexibility that this concept could allow.**
  - **The S1 test organization appears to be a success, and the PAC looks forward to hearing of progress and a schedule for S2.**
  - **The PAC endorses research on SC cavity processing, and also notes the importance of obtaining good statistical data; this will be helped by the experience which will be obtained on the XFEL project construction.**
  - **The flow of information on SC cavity processing and tests between labs is strongly encouraged. The same is true for information from industry, although the PAC acknowledges the difficulties that may arise in this case.**
  - **The PAC notes with interest the recent GDE efforts on a “Minimum Machine” and cost-reduction; it welcomes the study of the single-tunnel concept, and other studies on simplifications to the accelerator facility. While cost reduction is important, the PAC notes that this may not necessarily be desirable if it leads to more risk, or precludes some future options such as eventually achieving the beam current specification or 1 TeV operation.**

Industrial Visits - Website

international linear collider

ILC Global Design Effort Project Manager visit to SCRF cavity manufacturers

February - March 2009

In early 2009 the ILC Global Design Effort Project Managers (Akira Yamamoto, Marc Ross, and Nick Walker) visited and were graciously hosted by many of the world's top superconducting RF cavity manufacturers. The objective of the visit was to:

1. Learn industrial status and possible future at cavity manufacturers.
2. Communicate the ILC GDE Technical Design Phase R&D Plan.
3. Request further industrial R&D effort, particularly to improve "field gradient" and "cost effective production" in order to prepare for the industrialization (mass production).
4. Establish close communication and a confident relationship between ILC GDE and vendors.

This web page is intended to capture the material presented to vendors and to include key references.

Global R&D Effort of SCRF Cavity Development for the International Linear Collider (pdf, 5Mb, English)
[illegible] (pdf, 20Mb, Japanese)
Akira Yamamoto, Marc Ross, and Nick Walker - Project Managers for the ILC Global Design Effort, **material presented to each of the SCRF cavity manufacturers.**

Superconducting RF Cavity Development for the International Linear Collider (pdf, 4Mb)
Akira Yamamoto for the ILC Global Design Effort, **paper presented at Applied Superconductivity Conference 2008 (ASC 2008).**

Global R&D effort for the ILC linac technology (pdf, 4Mb)
Akira Yamamoto for the ILC Global Design Effort, **paper presented to EPAC 2008.**

Reference Design Report

Download the full report

Volume 3 - Accelerator: Download the pdf (20MB)

ILC Research and Development Plan for the Technical Design Phase

Download the pdf

(Last updated: 25 February 2009)

PAC Oct08 Recommendations

- Accelerator (continued)
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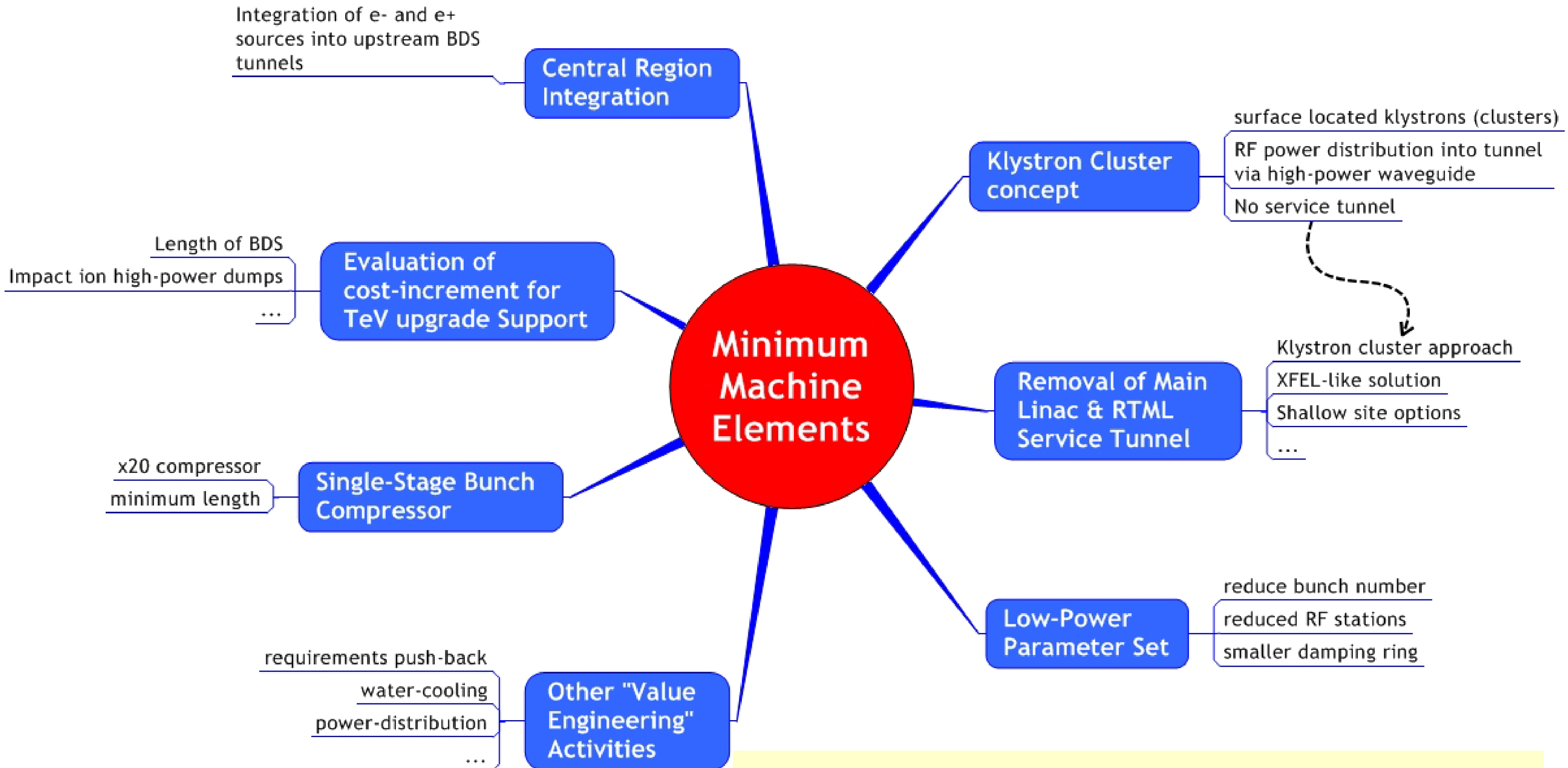
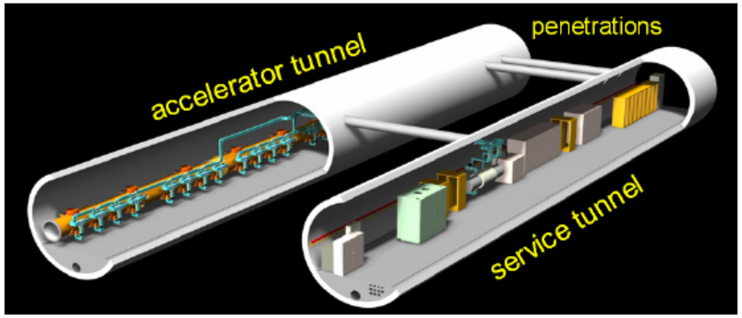
Identified Minimum Machine Elements

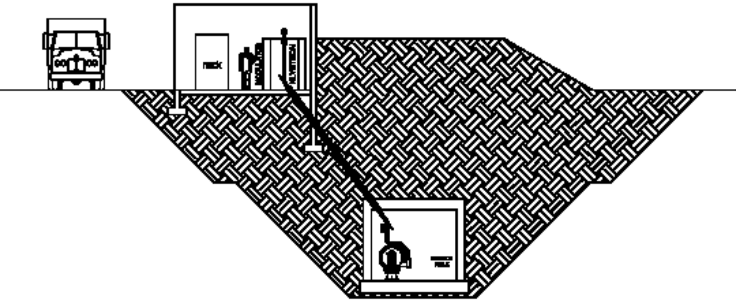


See Ewan Paterson Presentation

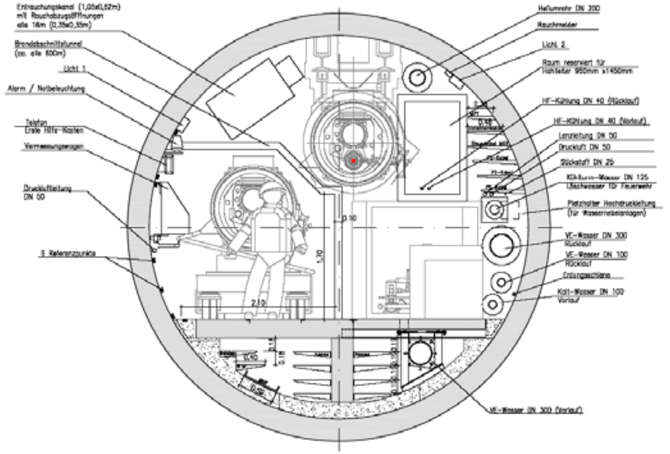
Main Linac & Support Tunnel



- RDR (two-tunnel)
  - **Access to equipment during ops**
    - Reliability/availability



- Shallow sites
  - **Cut and cover like solutions**
  - **“service tunnel” on the surface**



- Single tunnel
  - **European XFEL-like solution**
    - availability / reliability

Additional Remarks

- Definition of the Technical Design Report
- Work toward Project Implementation Plan
- Detector LOIs and Machine Detector Interfaces

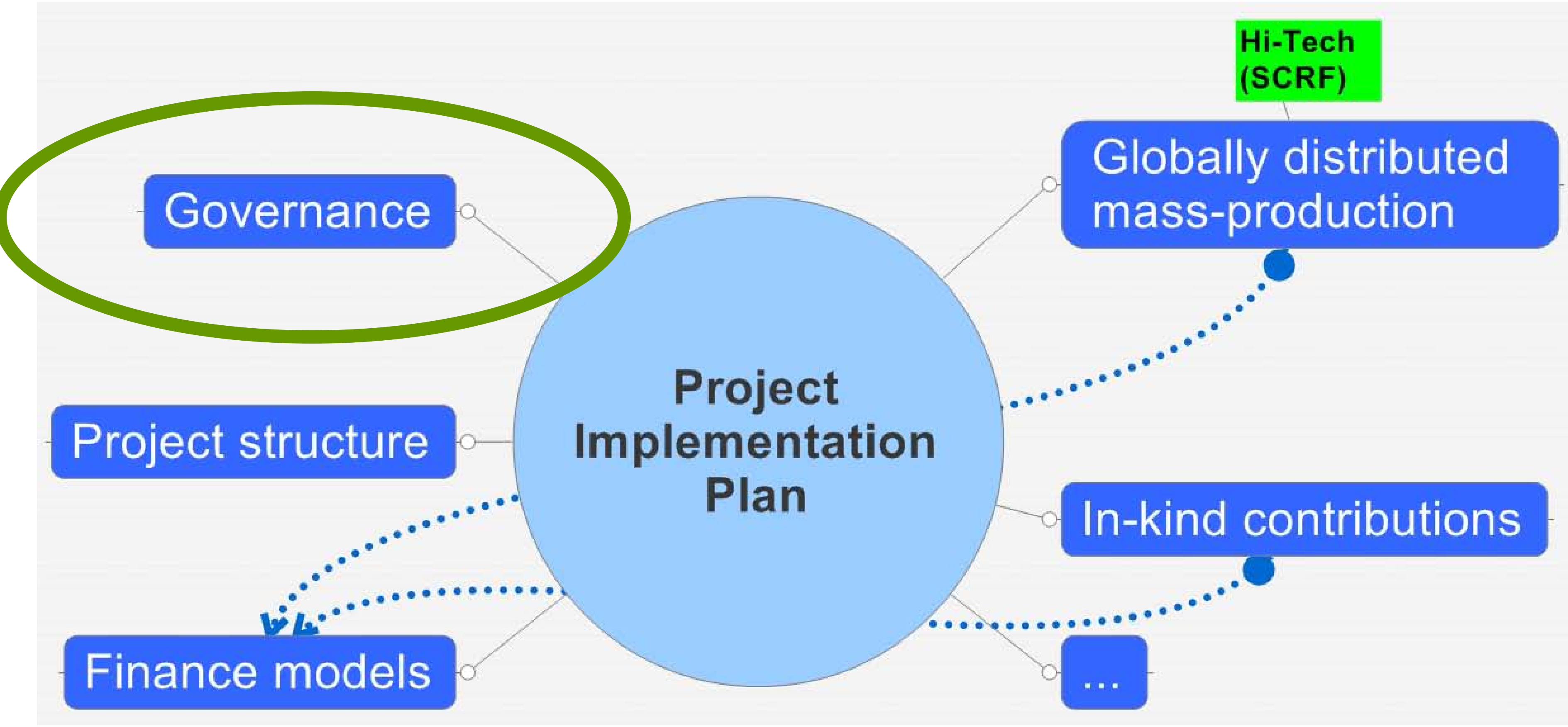
Technical Design Report

- What will it be?
  - **Cost performance optimized technical design**
  - **It will include new “value” estimate**
  - **It will include a project implementation plan**
- Who will it be for?
  - **It will be a detailed design and project plan ready for serious consideration by potential collaborating governments.**
- What it will not be?
  - **It will not be a complete engineering design with drawings, etc.**

Technical Design Report

- What about LHC results?
  - The LHC will need to be a success technically (energy, luminosity and duty cycle)
  - LHC science will need to ‘validate’ the science case.
- Who about CLIC?
  - Joint work with CLIC will help make technical, cost and readiness comparisons possible, if needed.
  - Will LHC points to a ~ 1 TeV machine?
- Will our job be done? (What happens after 2012?)
  - Continuing R&D demonstrations, ADC and industrialization
  - Funding could become more difficult, without a potential project is in sight.

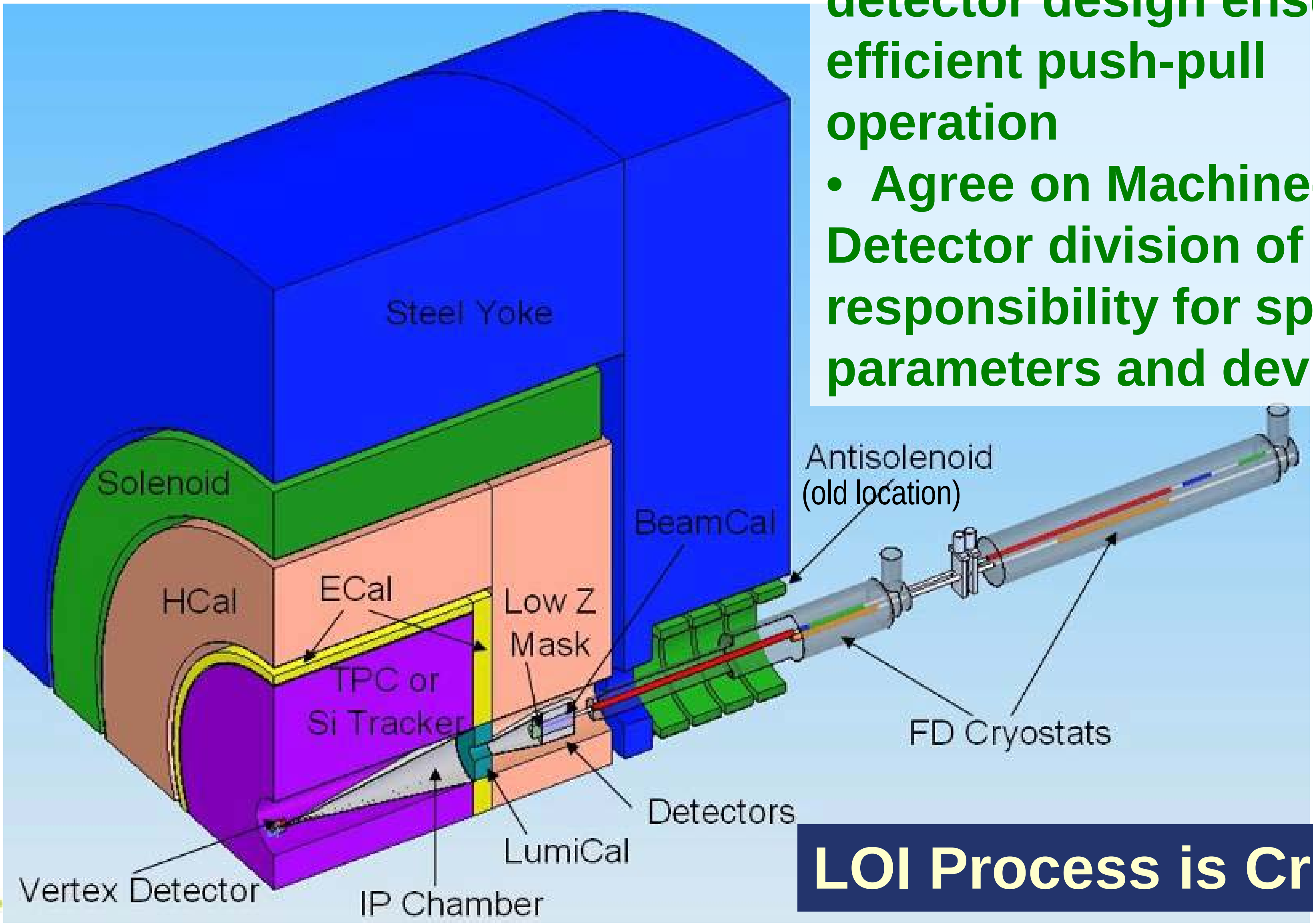
Project Implementation Plan (PIP)



PIP – Initial Studies

- Brian Foster leads the GDE governance group
  - Examining the main recent projects approved/in preparation: ALMA, FAIR, ITER, SKA, XFEL…
  - Contact made with key individuals in projects. Information gathered and presented.
  - E.g. on funding - 2 main models for funding: Host (~50%) + regional contributions (2 x~25%) or Host (~50%)+member states (n x~10%) (ITER). Balance of in-kind/cash?

IR Integration



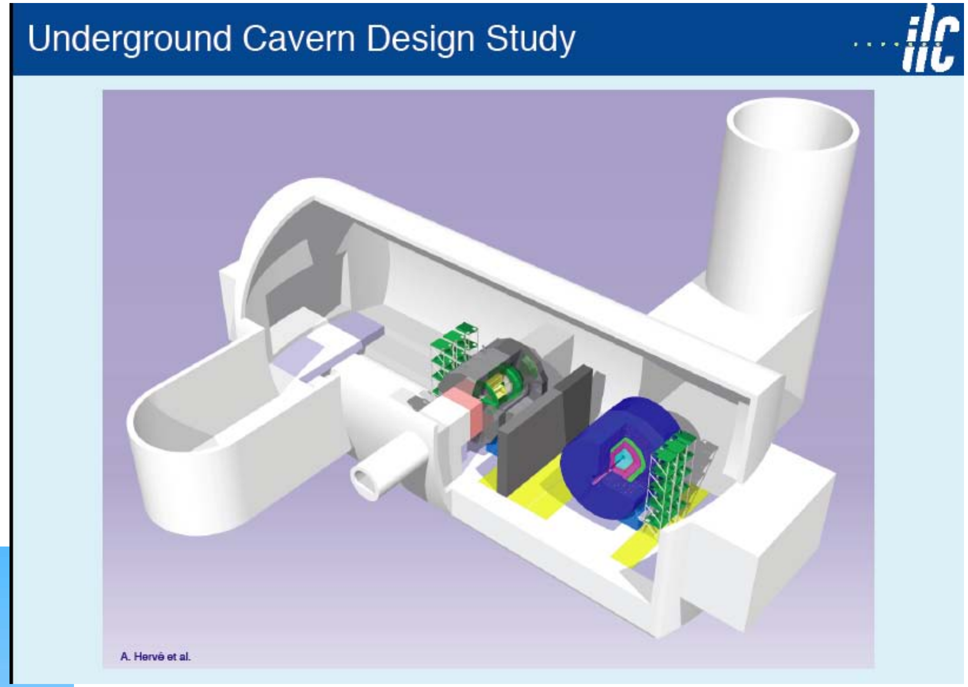
CHALLENGES:

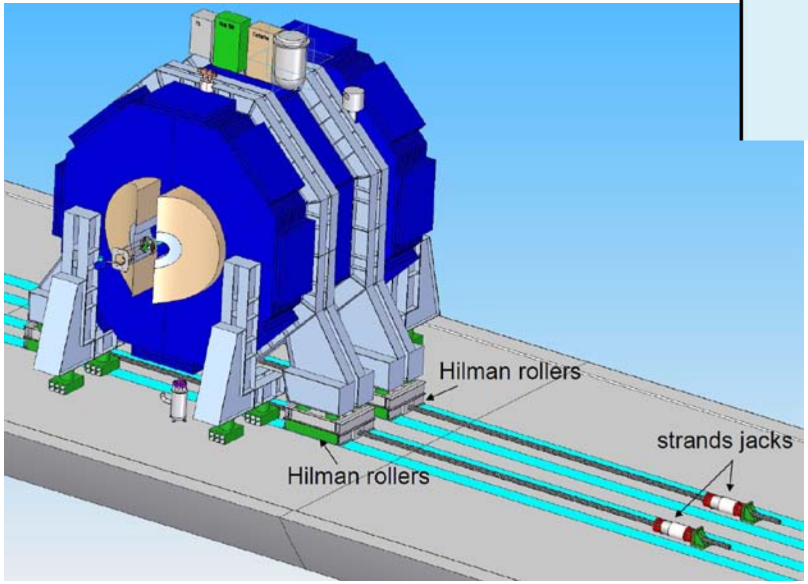
- **Optimize IR and detector design ensuring efficient push-pull operation**
- **Agree on Machine-Detector division of responsibility for space, parameters and devices**

LOI Process is Crucial

MDI and Detector LOIs

"PUSH – PULL"
Interaction Region
for
two detectors





Enabling the next phase of designing a feasible system to practically switch between detectors

Summary / Conclusions

- We are on track to be able to ready to propose the ILC on a time scale of ~2012 (or before!)
  - **GDE R&D demonstrations**
  - **Cost/risk/performance optimized design concept**
  - **Detector LOIs → Machine Detector Interfaces**
  - **Re-baseline (2010)**
  - **Technical Design Report (end of 2012)**
  - **Project Implementation Plan**

  - **LHC results to motivate the project**
  - **Outreach to generate support from science community, funding agencies, etc**