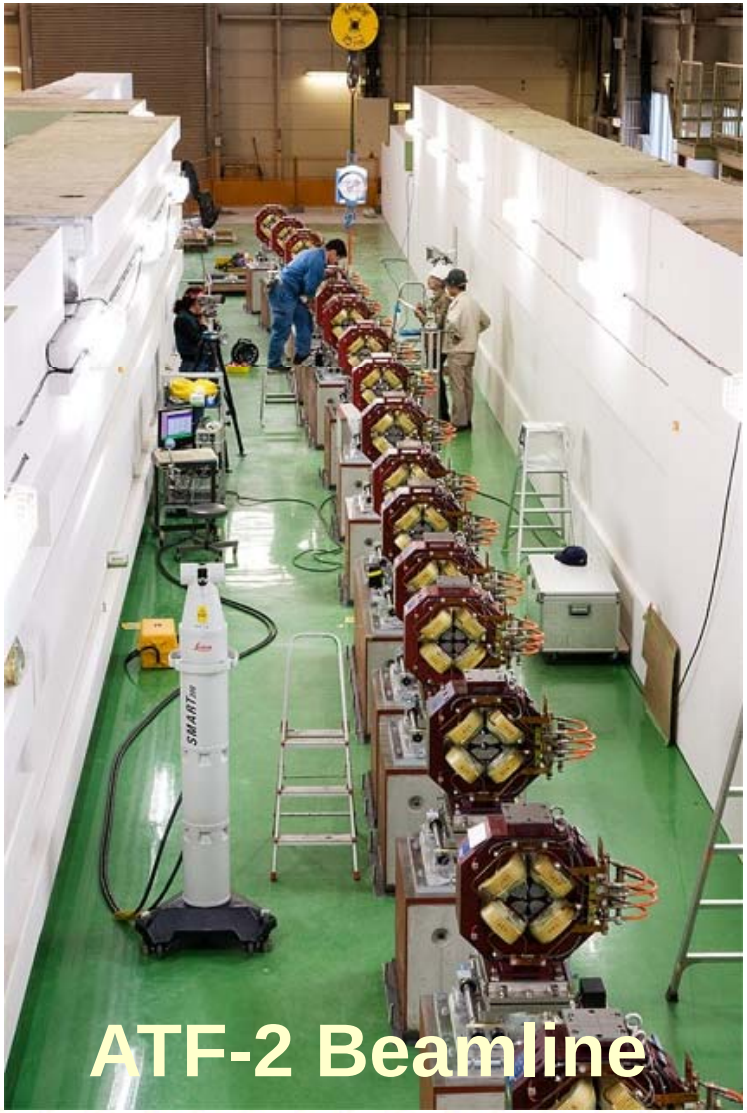


GDE Status, Overview and Plans

Barry Barish

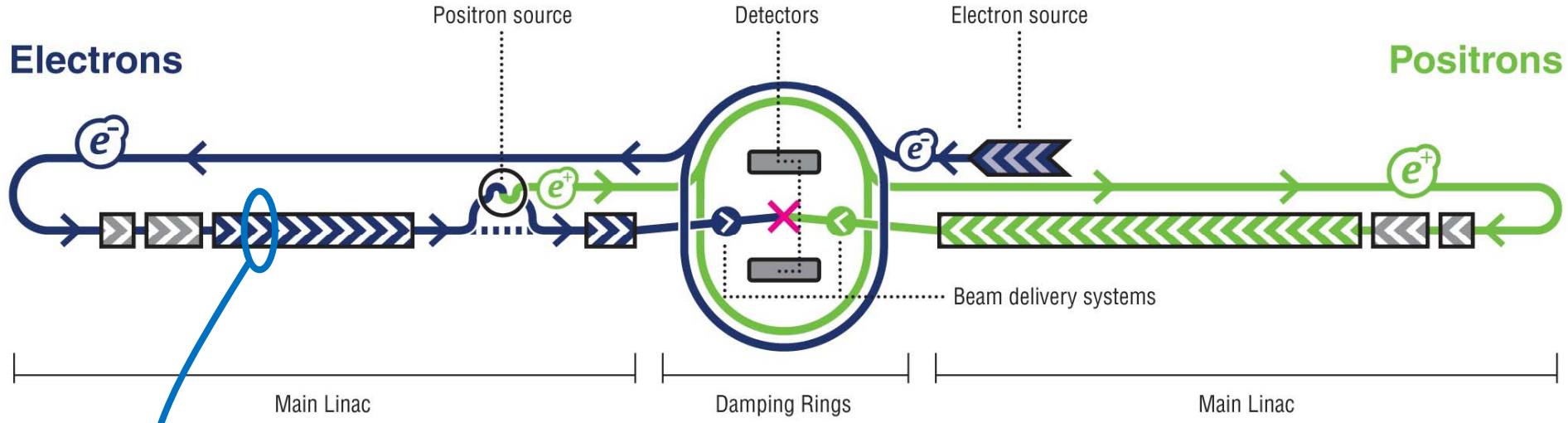
ILC08 - Chicago

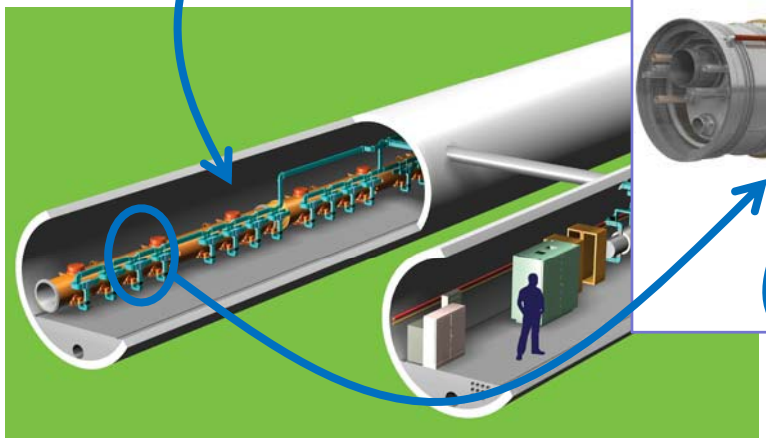
16-Nov-08

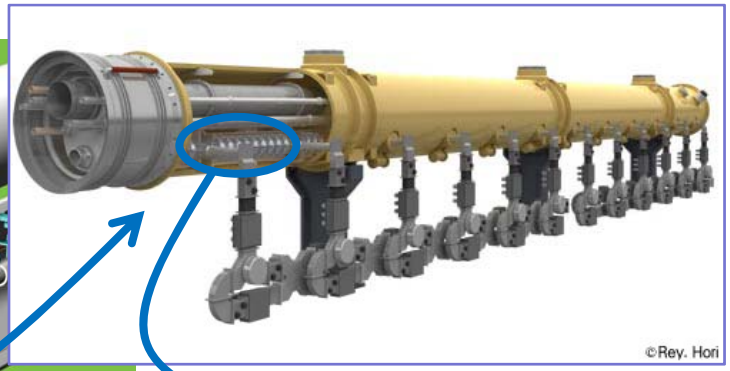
Outline

- Present status of global effort
- Plans for 2009 and beyond
- Status of R&D programs
- Minimum Machine Design Studies
- ILC/CLIC Collaboration
- Rebuilding the U.S. ILC R&D Program
- Conclusion

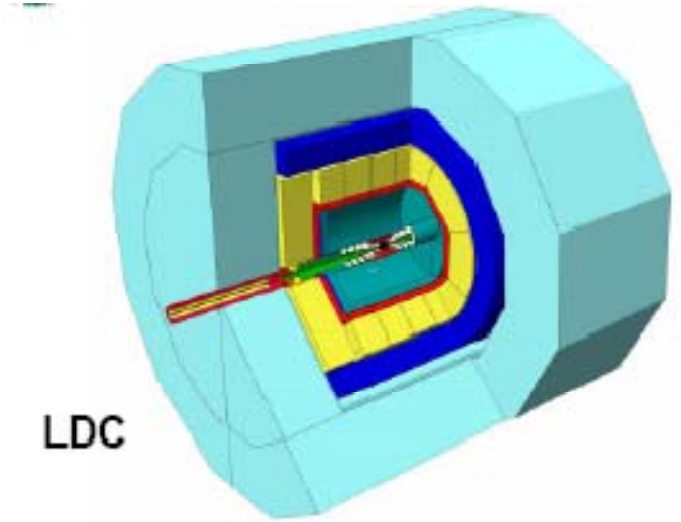
ILC Reference Design

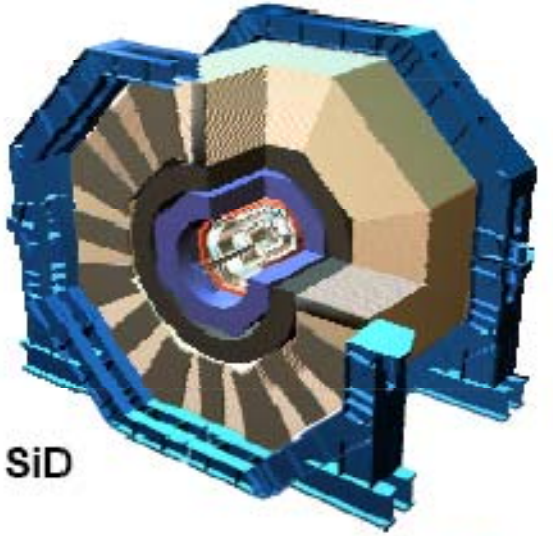


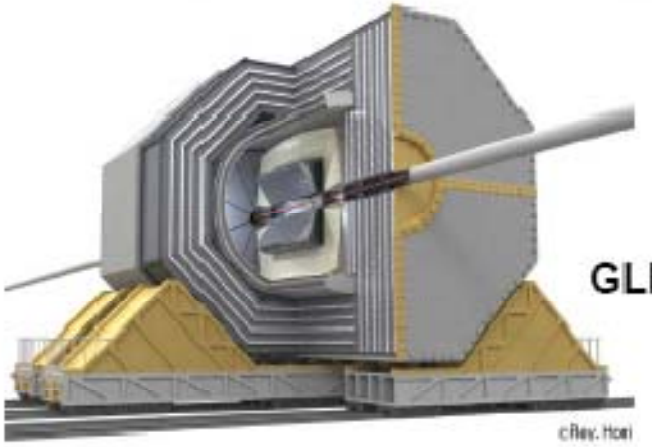


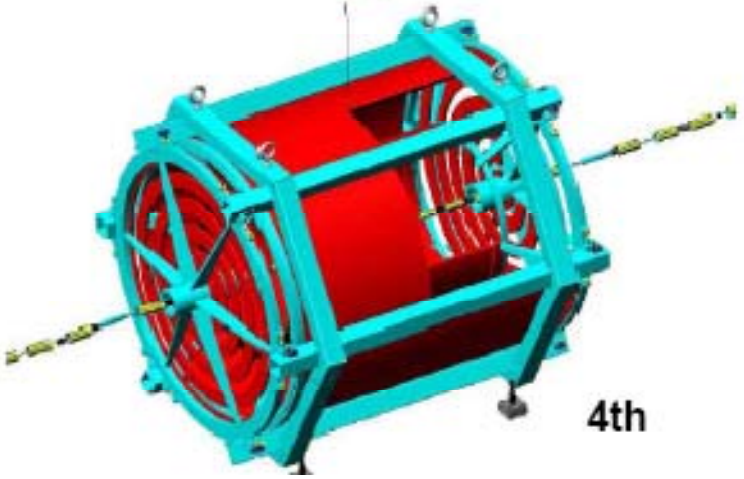


Detector Concepts Report

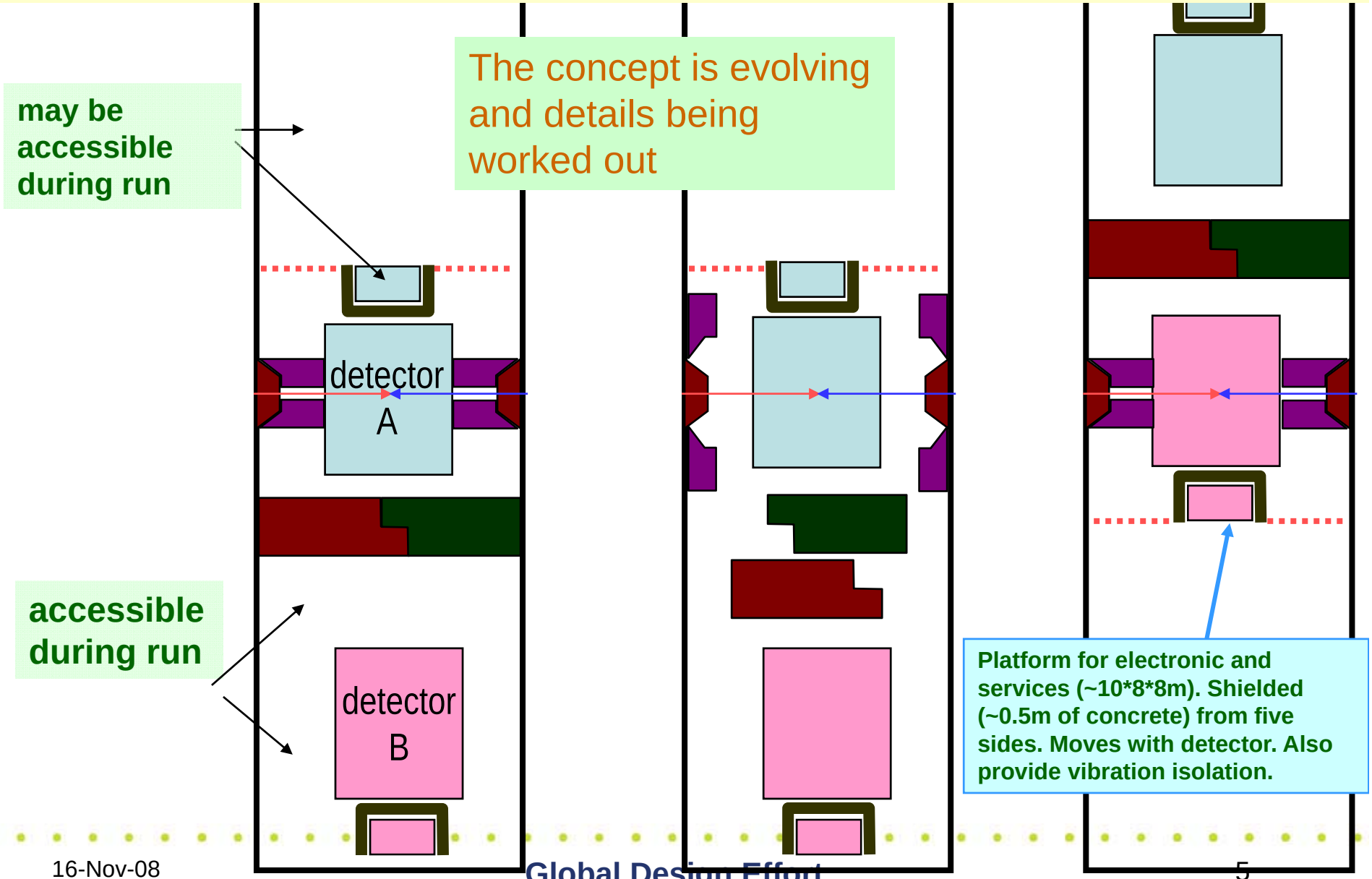








Push-Pull Concept for two detectors



BLACK DECEMBER 2007

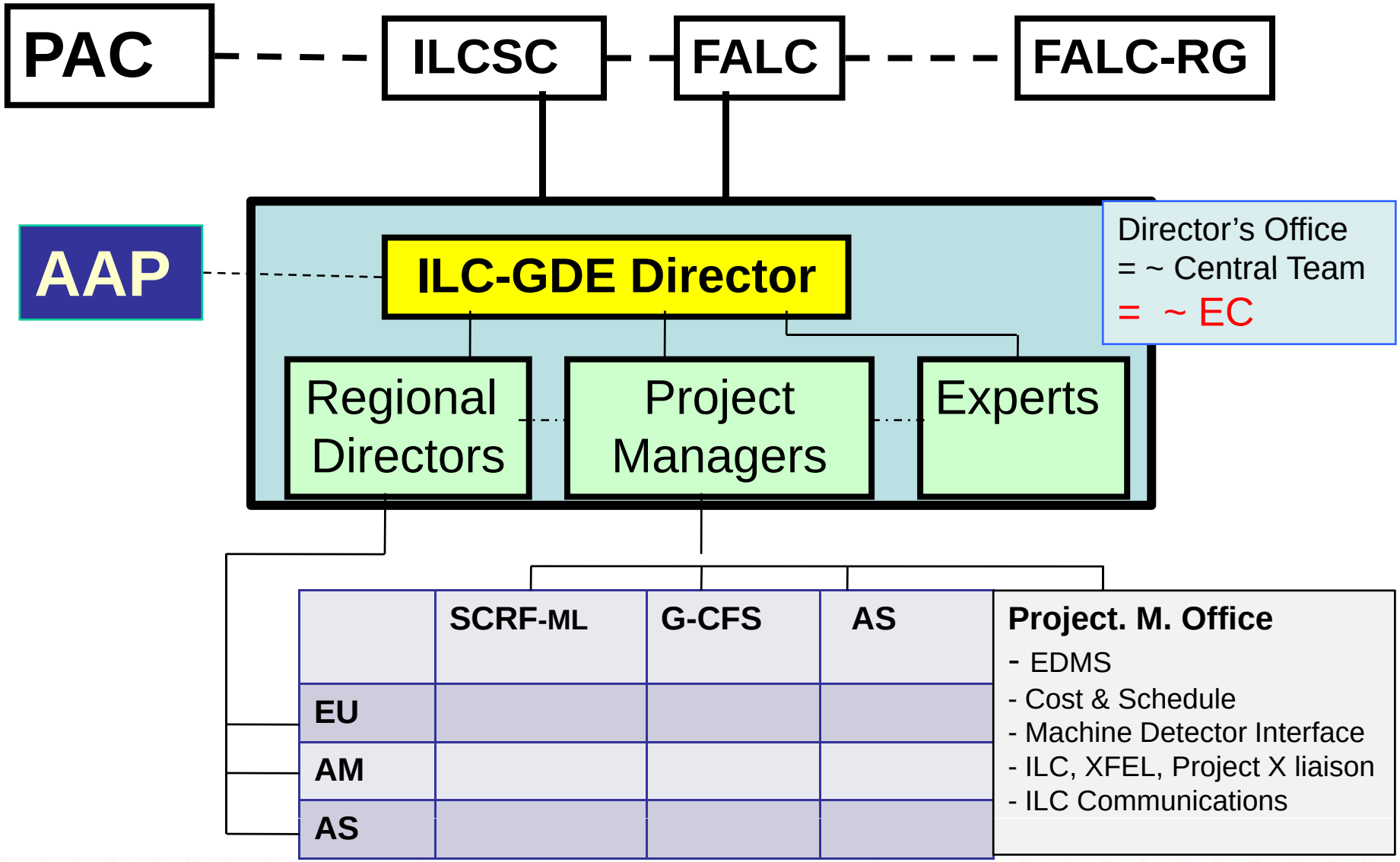
- Without warning, severe budget cuts in the USA and the UK
  - **In UK, we preserved support for key scientists and their teams, but lost broader program (40 FTE to ~ 15 FTE)**
  - **In US, budget reduced FY98 to $15M, essentially already spent last December. The US program has effectively been on hold for 9 months.**

- Global Program has impressively moved on in the face of these devastating problems
  - **The core of our program is focused on large R&D facilities; Global collaboration increased toward prioritized goals**

Next: Build a Solid Technical Design

- Complete crucial R&D to reduce technical risk
  - **SCRF gradient; final focus; electron cloud**
- Optimize the ILC design for coherence, simplicity and cost / performance
  - **Minimum Machine**
- Develop capability to industrialize, construct ILC worldwide and develop international model for governance
  - **Project Implementation Plan**

ILC-GDE Organization Chart



R&D Plan - Technical Design Phase

ILC Research and Development Plan for the Technical Design Phase

Release 2

June 2008

ILC Global Design Effort

Director: Barry Barish

Prepared by the Technical Design Phase Project Management

Project Managers: Marc Ross, Nick Walker, Akira Yamamoto

- First Official Release June 08
- A 50 page document with details of all programs and schedules
- Next review and release: December 08

Major R&D Goals for TDP 1

SCRF

- **High Gradient R&D - globally coordinated program to demonstrate gradient for TDP by 2010 with 50%yield; 90% yield by 2012**

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

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

Status of 9-Cell Cavity R&D

- **Europe**
  - **“Gradient” improved (<31.5> MV/m) with Ethanol rinse (DESY):**
  - **Industrial (bulk) EP demonstrated (<36> MV/m) (DESY)**
  - **Large-grain cavity (DESY)**
  - **Surface process with baking in Ar-gas (Saclay)**
- **America(s)**
  - **Gradient distributed (20 – 40 MV/m) with various surface process (Cornell, JLab, Fermilab)**
  - **Field emission reduced with Ultrasonic Degreasing using Detergent, and “Gradient” improved (JLab)**
- **Asia**
  - **“Gradient” demonstrated, 36MV/m (LL, KEK-JLab), and 28 MV/m (TESLA-like in cryomodule, KEK)**

High gradients achieved in all regions but still with variable yield

New -- Optical Inspection System

For visual inspection of cavity inner surface.

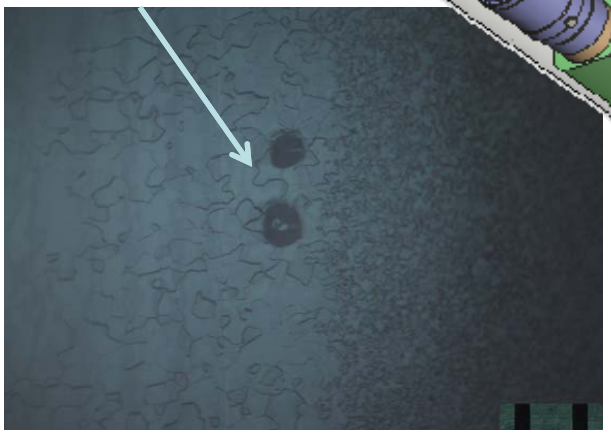
Iwashita (Kyoto) and Hayano (KEK) et al.

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

motor & gear for mirror

camera & lens

~600μm beads on Nb cavity

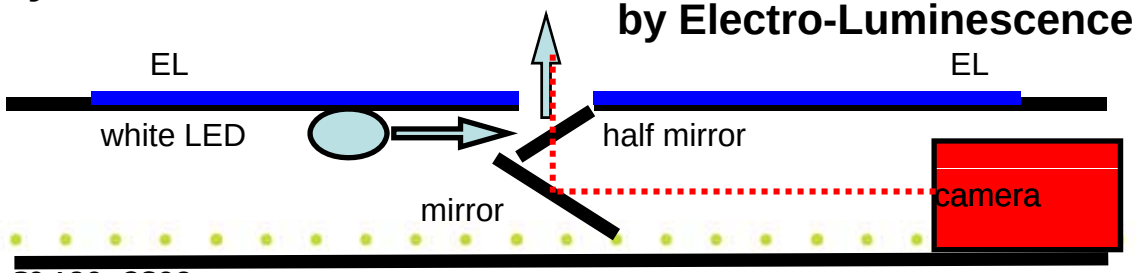


sliding mechanism of camera

DESY starting to use this system in cooperation with KEK

perpendicular illumination by LED & half mirror

tilted sheet illumination by Electro-Luminescence



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) → ?	

SCRF: Plug Compatibility

R&D Phase

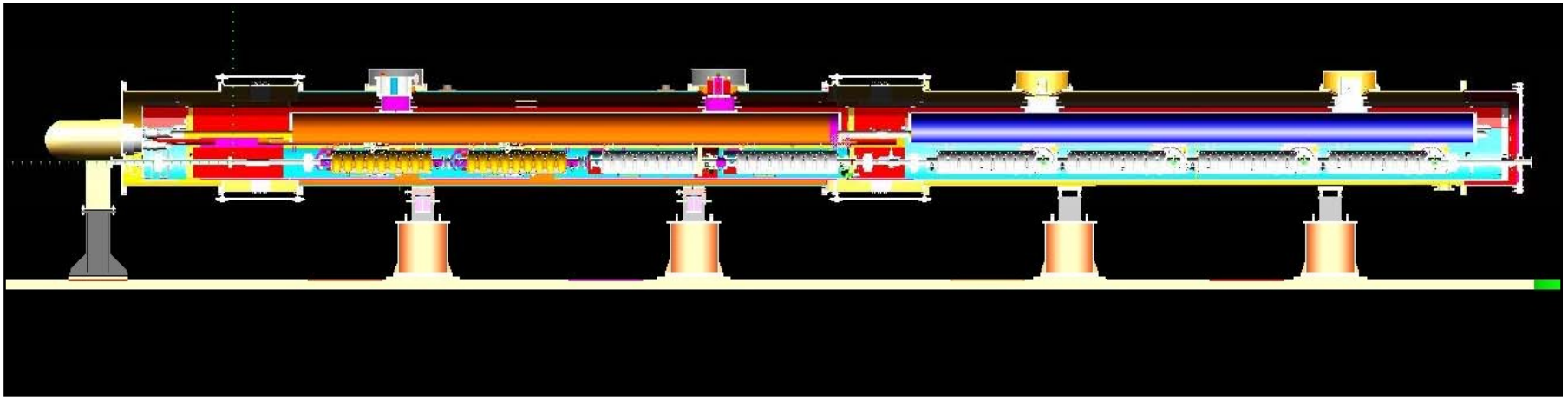
- Need to continue and encourage R&D effort to improve the "gradient" performance,
- "Improvement" comes from "some change", for example,
  - **Cavity Type: Tesla, Low-loss, Re-entrant**
  - **Material: Fine-grain or large grain**
  - **Surface treatment: EP, Rinsing,**
  - **Tuner type: Blade, Jack, etc.,**
  - **Input-coupler: how to simplify the assembly**

Construction Phase

- Need to keep multiple, regional participation and industrial competition

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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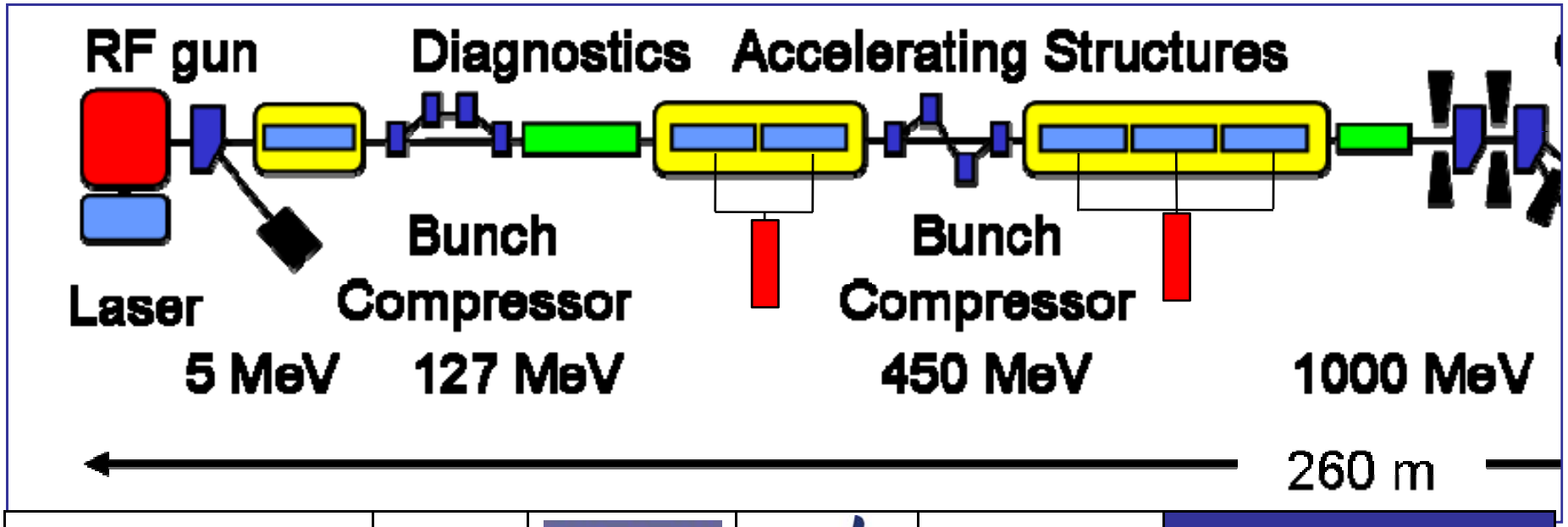
9mA Experiments in TTF/FLASH



		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

Goals of 9mA test

- Demonstrate energy stability <0.1% (LLRF) with high beam-loading
  - **Bunch to bunch**
  - **Pulse to pulse**
  - **Over many hours**
- Evaluate operation close to cavity limits
  - **Quench limits**
  - **Impact of LFD, microphonics etc.**
- Evaluate LLRF performance
  - **Required klystron overhead**
  - **Optimum feedback / feedforward parameters**
  - **Exception handling (development)**
  - **Piezo-tuner performance *etc.***
- Evaluate HOM absorber (cryoload)
- Controls development
  - **Software & algorithm development for ATCA (XFEL) LLRF system**

Global R&D Plan

Consensus in SCRF-TA

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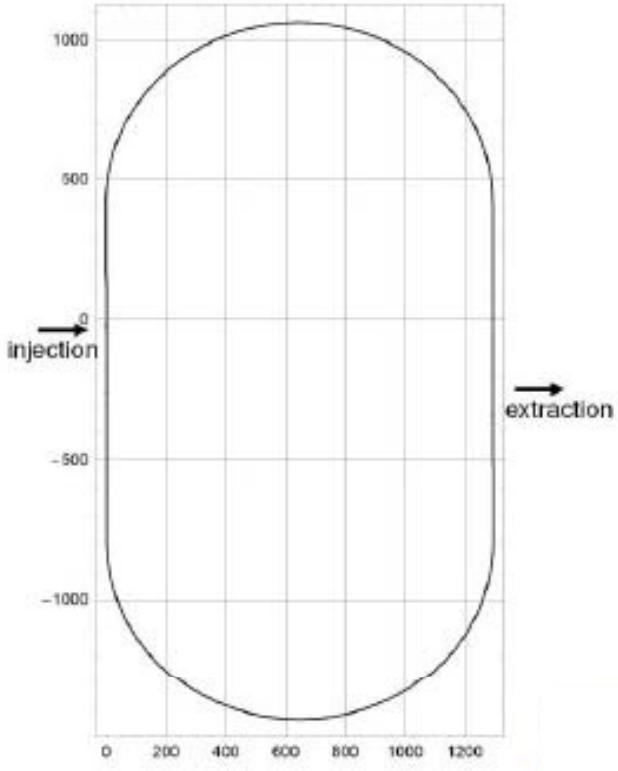
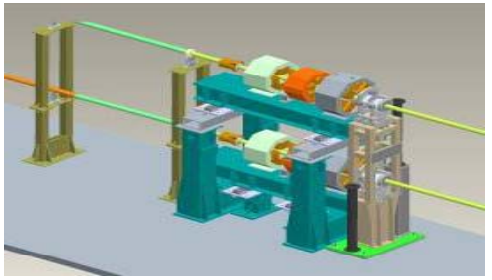
Damping Ring R&D

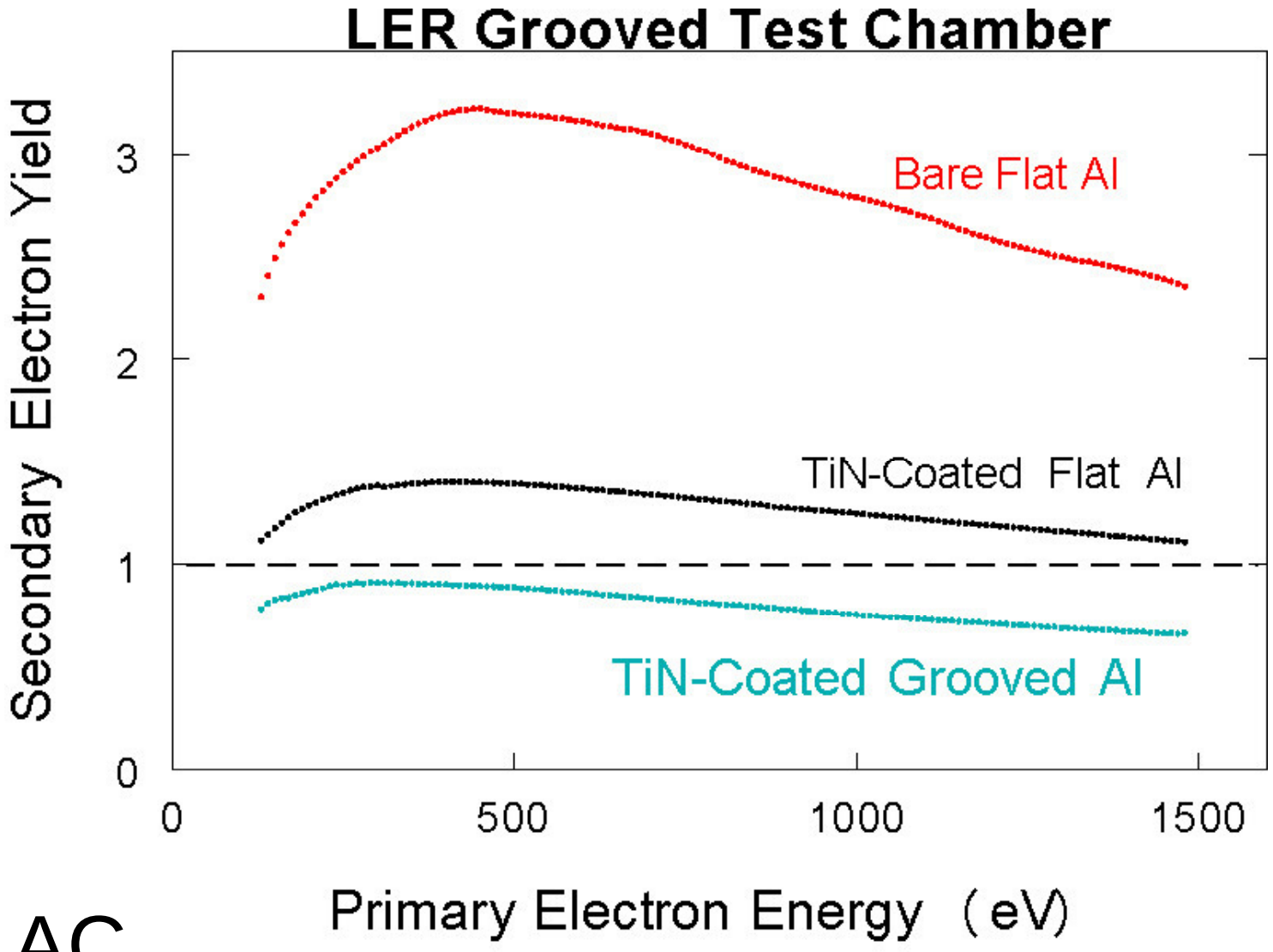
- DR has a flexible race track design
  - **6.4 km Circumference with >1 km straights, which contain, RF, Wigglers, Chicanes, Injection/ Extraction Systems**

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





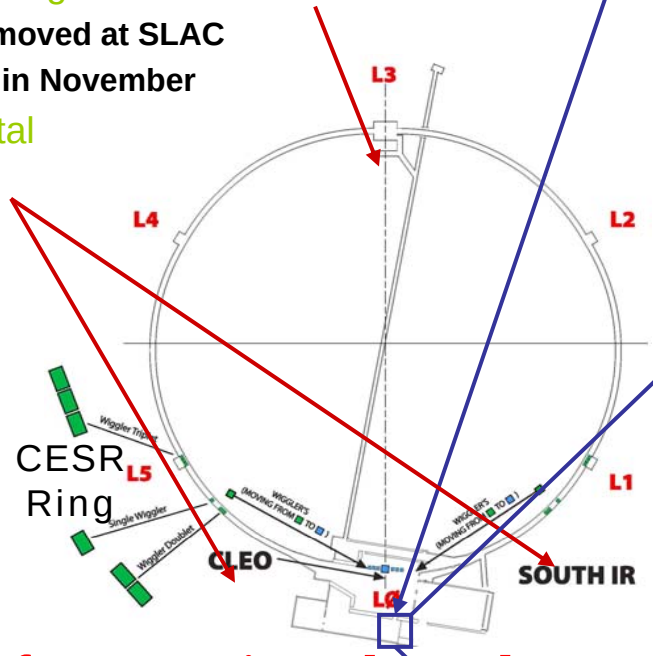
Electron Cloud – Simulation Results

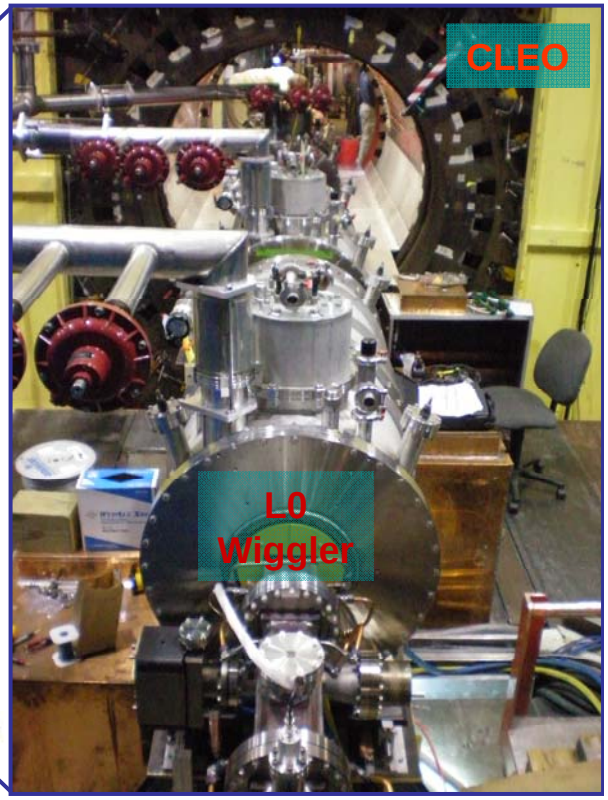


SLAC

Tests at CESR -- Reconfiguration

- **Electron Cloud Diagnostics**
  - L3 region prepped for arrival of PEP-II EC hardware including diagnostic chicane
    - **Hardware being removed at SLAC**
    - **Delivery to Cornell in November**
  - New EC experimental regions in arcs w/ locations for collaborator VCs
  - L0 region reconfigured as a wiggler straight
    - **Instrumented with EC diagnostics**
    - **Wiggler chambers with retarding field analyzers (fabricated at LBNL) - scheduled for installation ~Oct 23rd**
    - **Chambers with EC mitigation (TiN coatings by SLAC)**





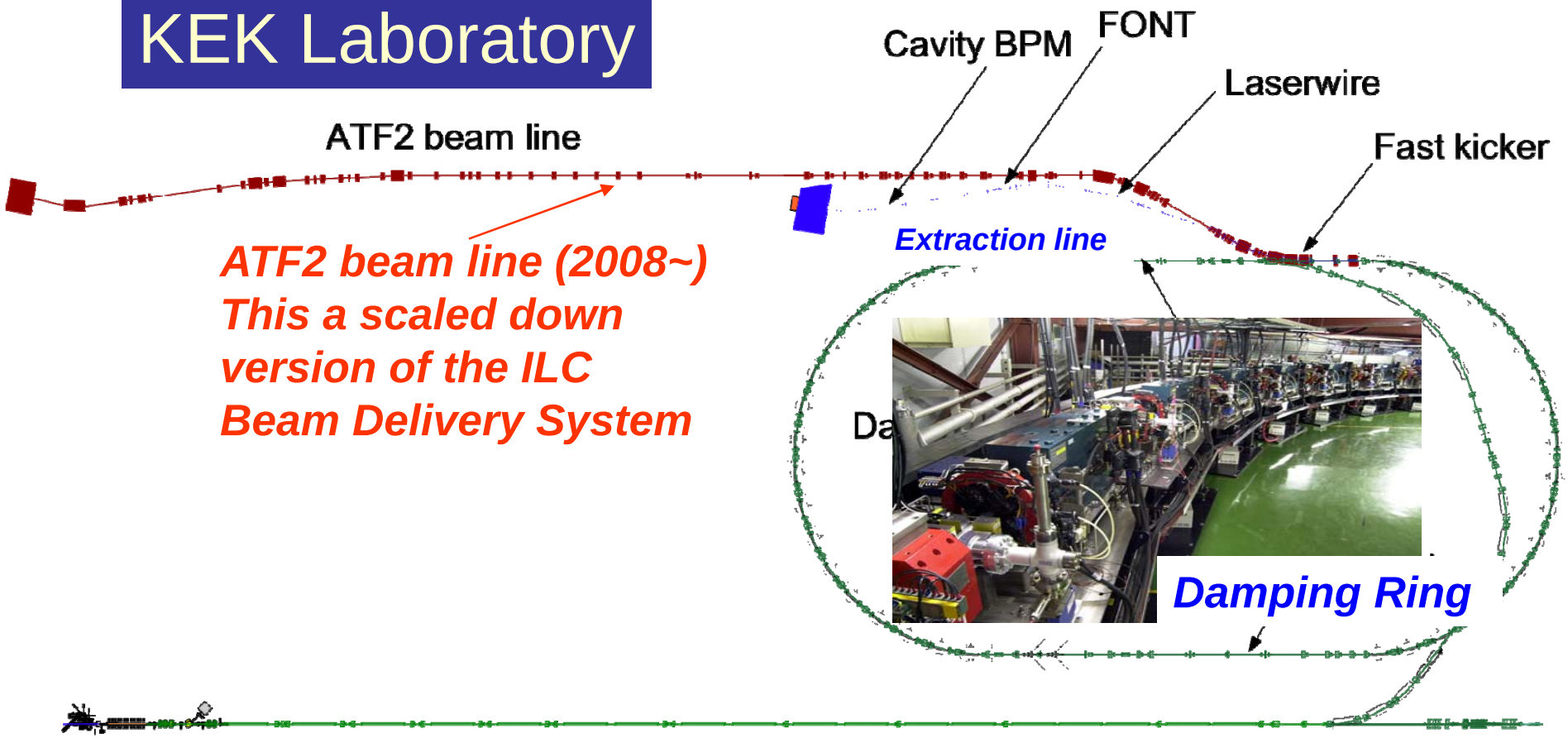
Re-commissioning for operations through Oct 27th

CesrTA dedicated experiments: Oct 27-Nov 10

Electron Cloud Experiments, Low Emittance Operation, X-ray Beam Size Monitor

Accelerator Test Facility – ATF/ATF2

KEK Laboratory



ATF2 beam line (2008~)
This a scaled down version of the ILC Beam Delivery System

Photo-cathode RF gun (electron source)

S-band Linac
Δf ECS for multi-bunch beam

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

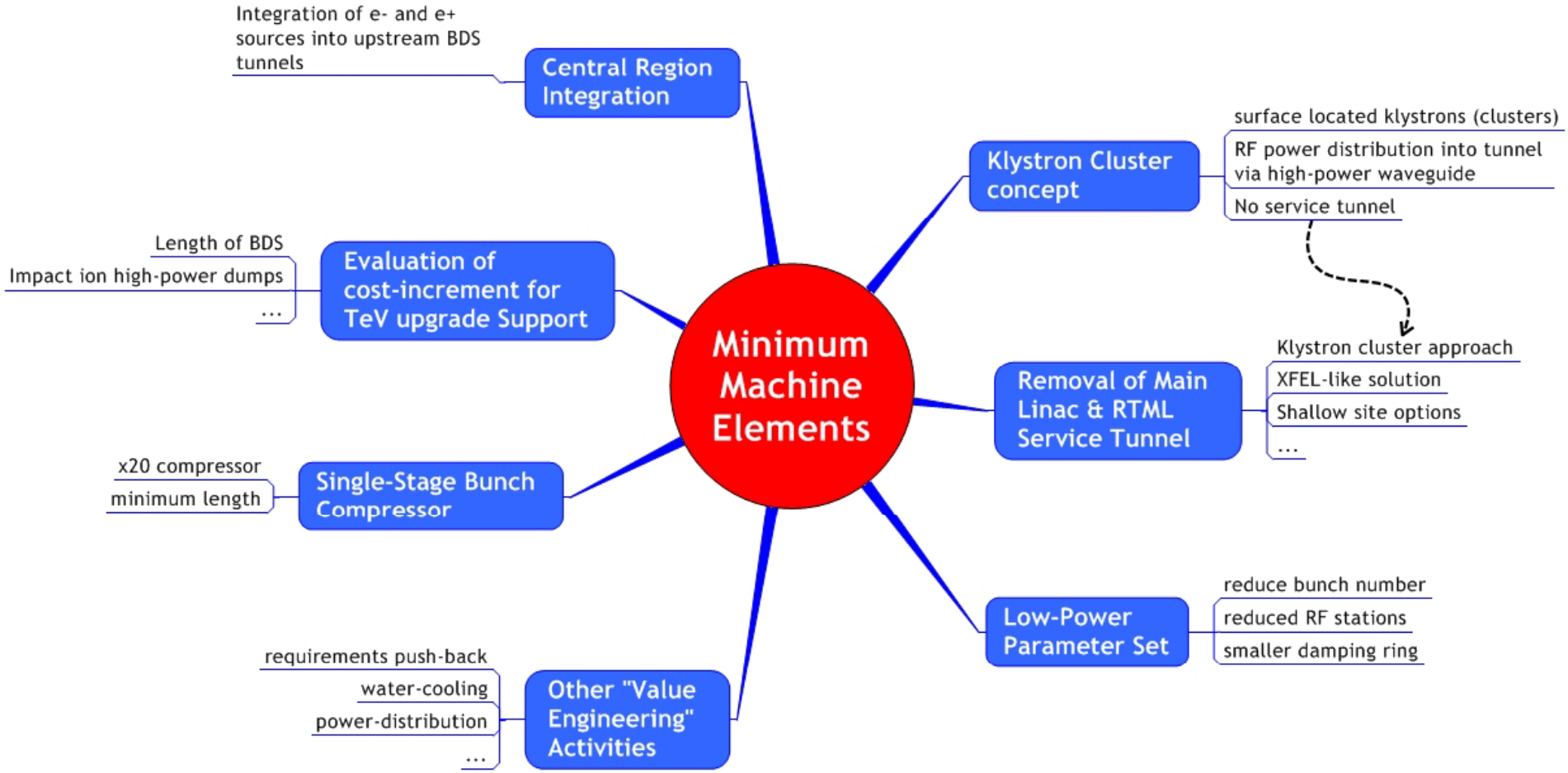
Commissioning this fall

Minimum Machine Design Effort

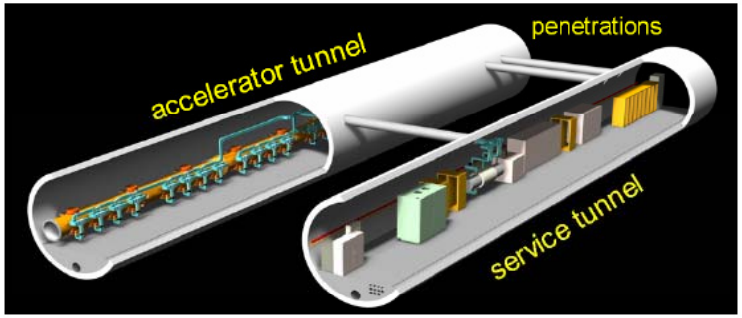
- "Minimum Machine" refers to a set of identified options (*elements*) which may simplify the design and be cost-effective

1. **Klystron Cluster concept**
2. **Central region integration**
3. **Low beam power option**
4. **Single-stage compressor**
5. **Quantify cost of TeV upgrade support**
6. **"Value engineering"**
7. **Single-tunnel solution(s)**

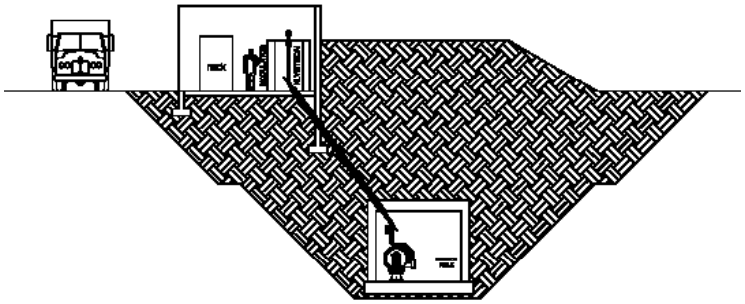
Identified Minimum Machine Elements



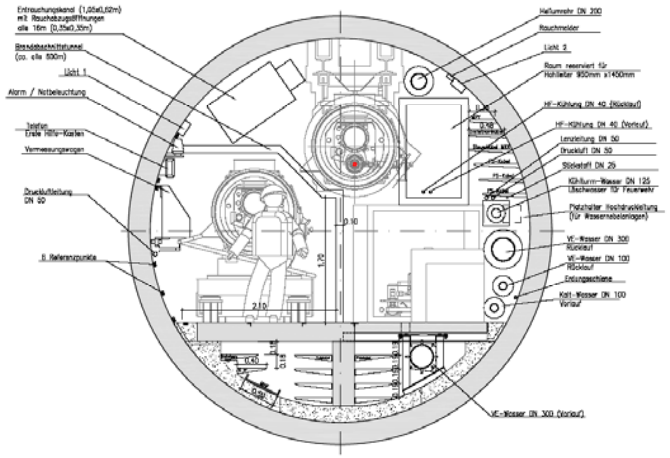
Main Linac & Support Tunnel



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

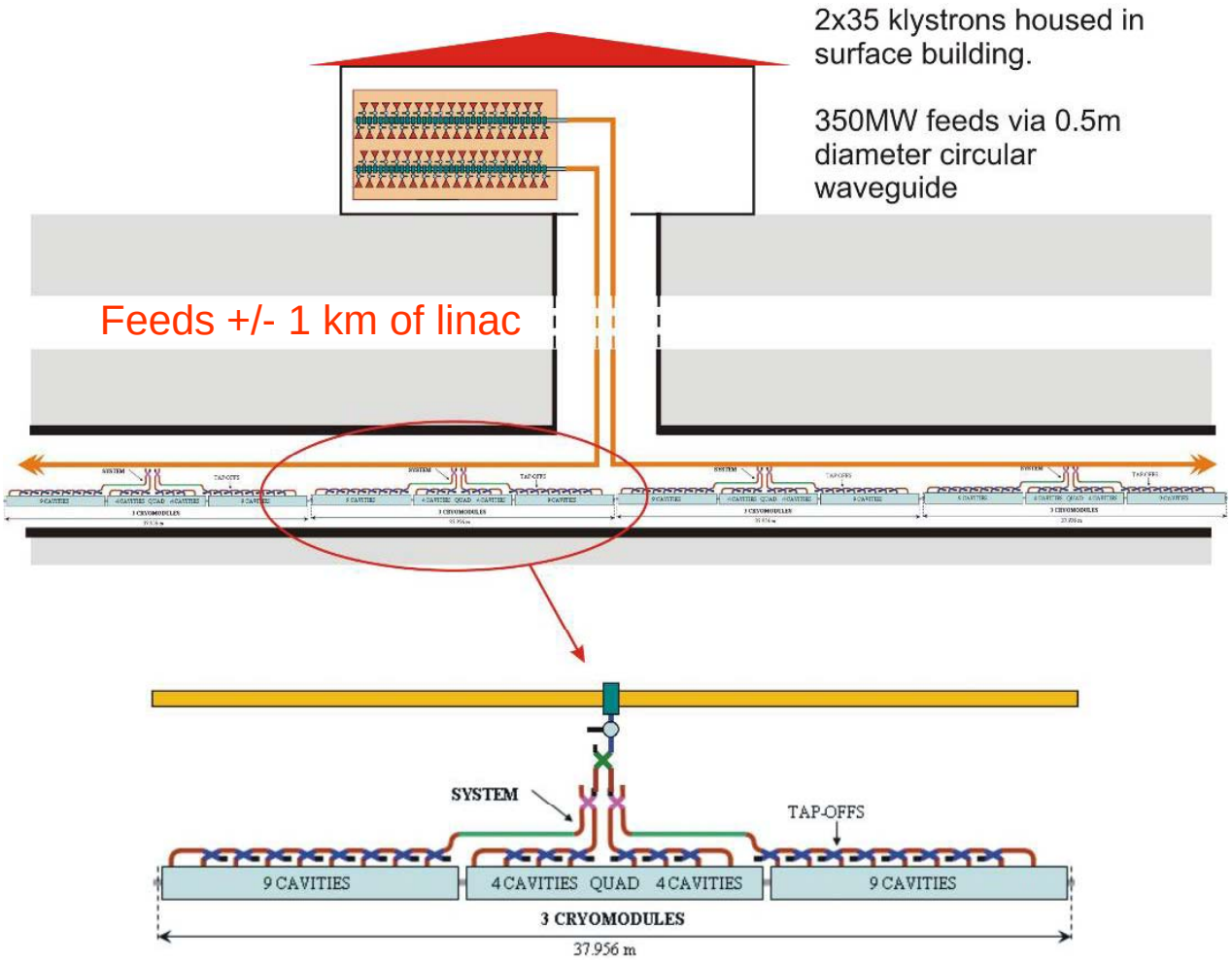


- Shallow sites
  - **Cut and cover like solutions**
  - **“service tunnel” on the surface**



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

Klystron Cluster Concept



Each tap-off from the main waveguide feeds 10 MW through a high power window and probably a circulator or switch to a local PDS for a 3 cryomodule, 26 cavity RF unit (RDR baseline).

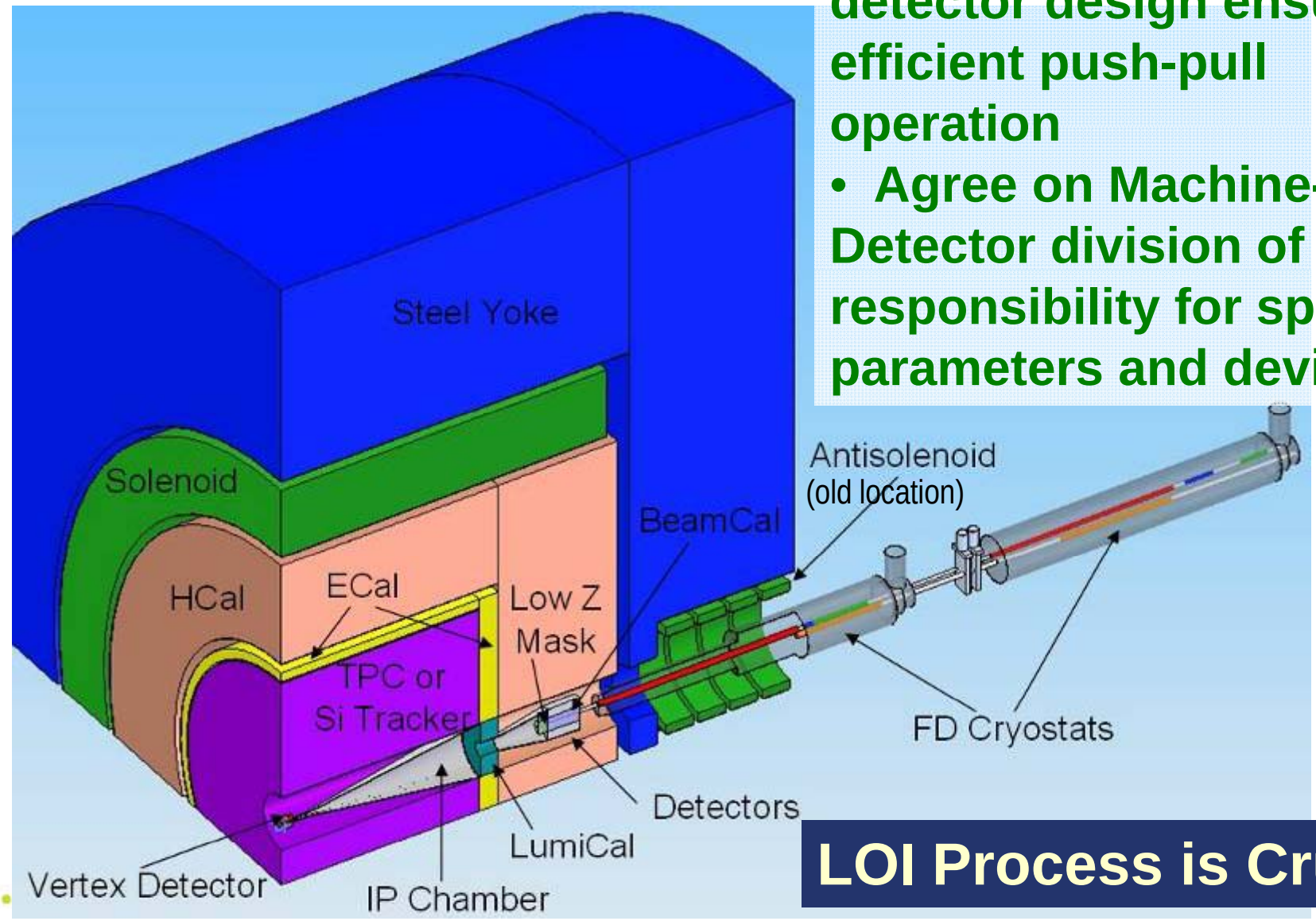
- RF power "piped" into accelerator tunnel
- Removal of service tunnel
- Access to klystrons & modulators maintained
- R&D needed to show power handling
  - **Planned (SLAC, KEK)**

SLAC

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

US Program --- P5 Report

- ***"The panel recommends for the near future a broad accelerator and detector R&D program for lepton colliders that includes continued R&D on ILC at roughly the proposed FY2009 level in support of the international effort. This will allow a significant role for the US in the ILC wherever it is built."***

Proposed FY2009 Budget = $35.3M

(caveat – continuing resolution)

US ILC Status

- Following the P5 recommendations, the ILC R&D program the US ILC FY09 baseline budget was established at $35.3M
- This was reduced to $29.5M due to the CR. This is an effective rate of 84% which is equal to the overall reduction in OHEP funding. This is sufficient to restart.
- Guidance at this level was send out at the start of FY09 and work is now ramping up at the national labs. We had managed to maintain the CESR TA program with NSF funding, a skeleton SRF gradient program, and certain elements of the GDE .
- Current CR planning is assuming that the CR goes away in March.
- With the resumption of funding we are starting to work on the US program for the balance of the R&D phase (2010 -> 2012)

CR Plan - Impact

- **Fermilab: hold labour and reduce M&S by $1.3M**
  - **Delay some CFS consultant contracts**
  - **Delay some cryomodule parts purchases**
  - **Remove S1 global dressed cavities – in principle (if the CR goes away in 6 months) there is no impact to this change**
  - **Nickel and dime**
- **SLAC: slow down and/or delay manpower ramp up and reduce M&S**
  - **ATF2 (at KEK) fully supported**
  - **HLRF system development slowed down**
  - **Slow down accelerator physics and tilt towards CESR TA support**
  - **Nickel and dime**

Joint ILC/CLIC R&D Areas

- **ILC-CLIC working groups formed in 2008. Goal is to optimize use of resources in areas of common or overlapping interests.**

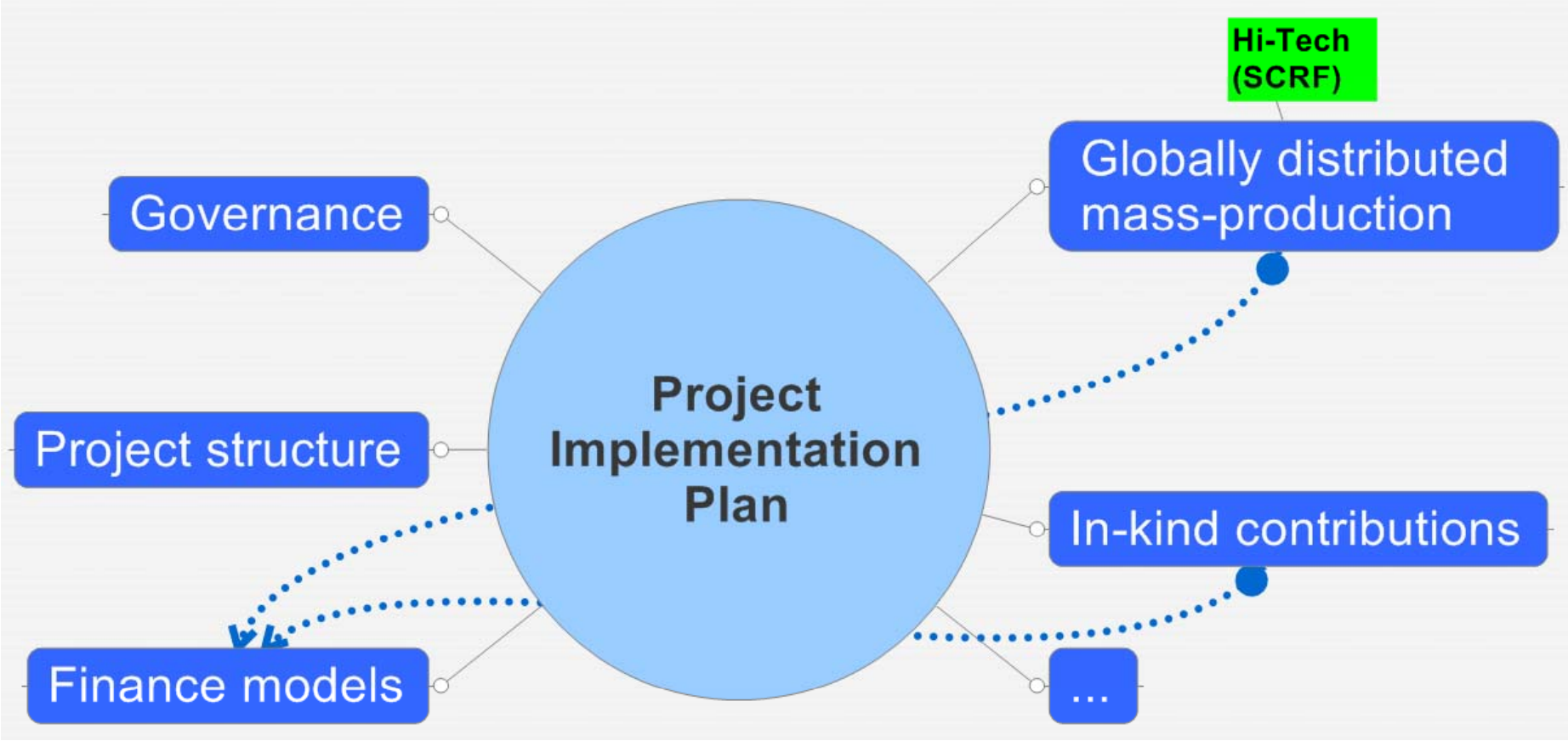
  - **Civil Engineering and Conventional Facilities (CFS):** Claude Hauviller/CERN, John Osborne/CERN, Vic Kuchler (FNAL)
  - **Beam Delivery Systems and Machine Detector Interface:** D.Schulte/CERN, Brett Parker (BNL), Andrei Seryi (SLAC),, Emmanuel Tsesmelis/CERN
  - **Detectors:** L.Linssen/CERN, Francois Richard/LAL, Dieter.Schlatter/CERN, Sakue Yamada/KEK
  - **Beam Dynamics:** A.Latina/FNAL), Kiyoshi Kubo (KEK), D.Schulte/CERN, Nick Walker (DESY)
  - **Cost & Schedule:** John Carwardine (ANL), Katy Foraz/CERN, Peter Garbincius (FNAL), Tetsuo Shidara (KEK), Sylvain Weisz/CERN

Project progress reports given at workshops such as

CLIC08 14-17 Oct,08 and ILC08 15-20 Nov,08

Two new groups are being added, E+ sources, Damping Rings

Project Implementation Plan



Final Remarks

- The global ILC R&D program has proven resilient to the budget crisis
- We are now in the technical design phase, which will culminate in 2012 with completion of crucial R&D and optimized cost / performance / risk design
- The US ILC program is being re-integrated and we now need to develop a new long range strategy for that program
- Collaborative work with CLIC is strengthening our effort. It will help prepare the community toward making a strong proposal for a linear collider when the science case is justified by LHC.