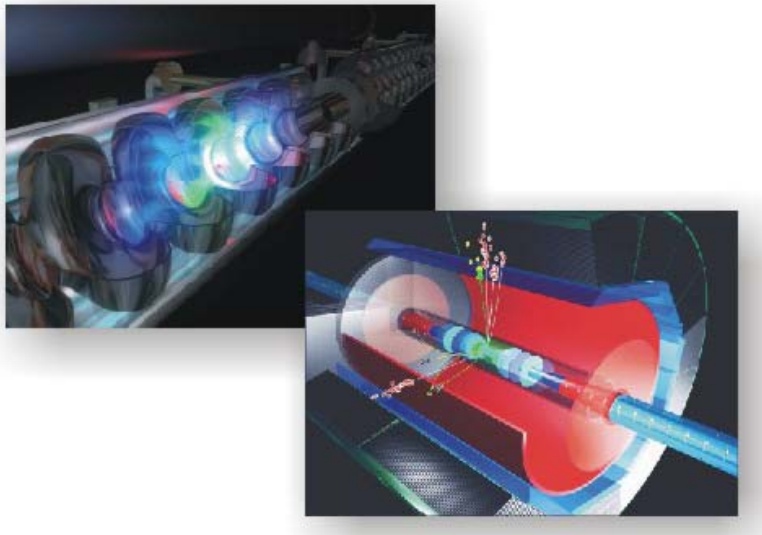
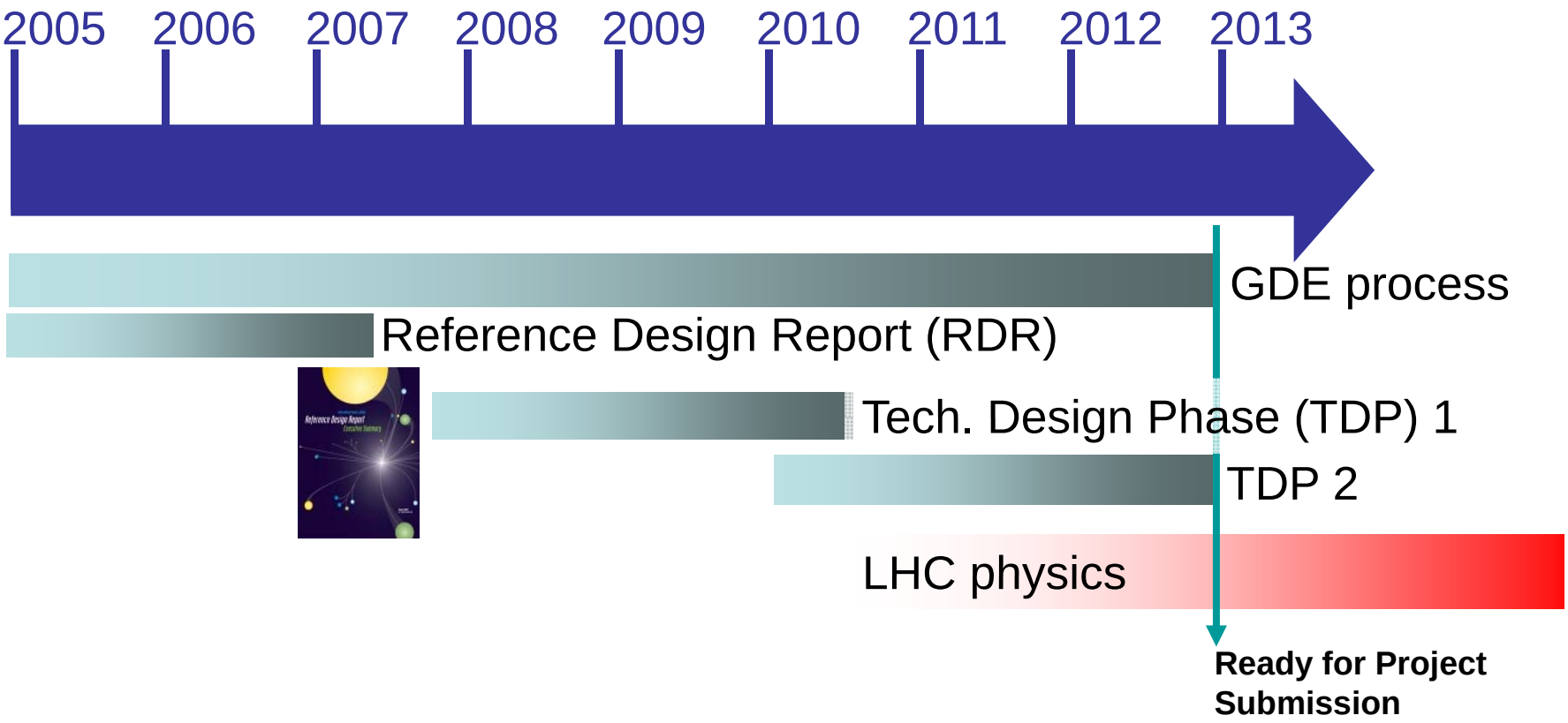
GDE Summary
(from the Project Managers Perspective)



Marc Ross
Nick Walker
Akira Yamamoto

ILC08 - 20.11.08

GDE ILC Timeline

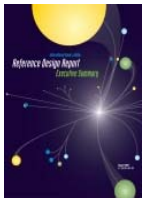


GDE ILC Timeline

2005 2006 2007 2008 2009 2010 2011 2012 2013

GDE process

Reference Design Report (RDR)



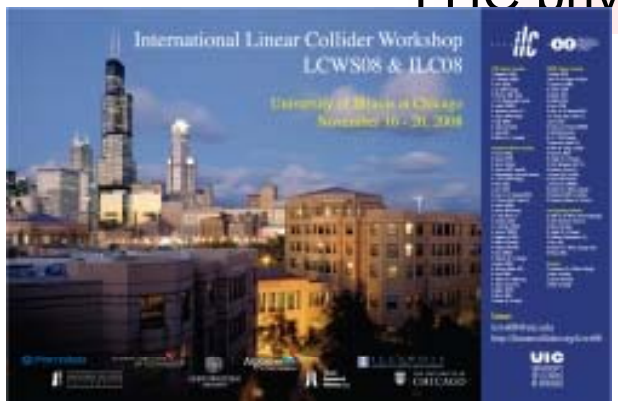
Tech. Design Phase (TDP) 1

TDP 2

LHC physics

Ready for Project Submission

~100 GDE participants
55 institutes
12 countries
3 regions



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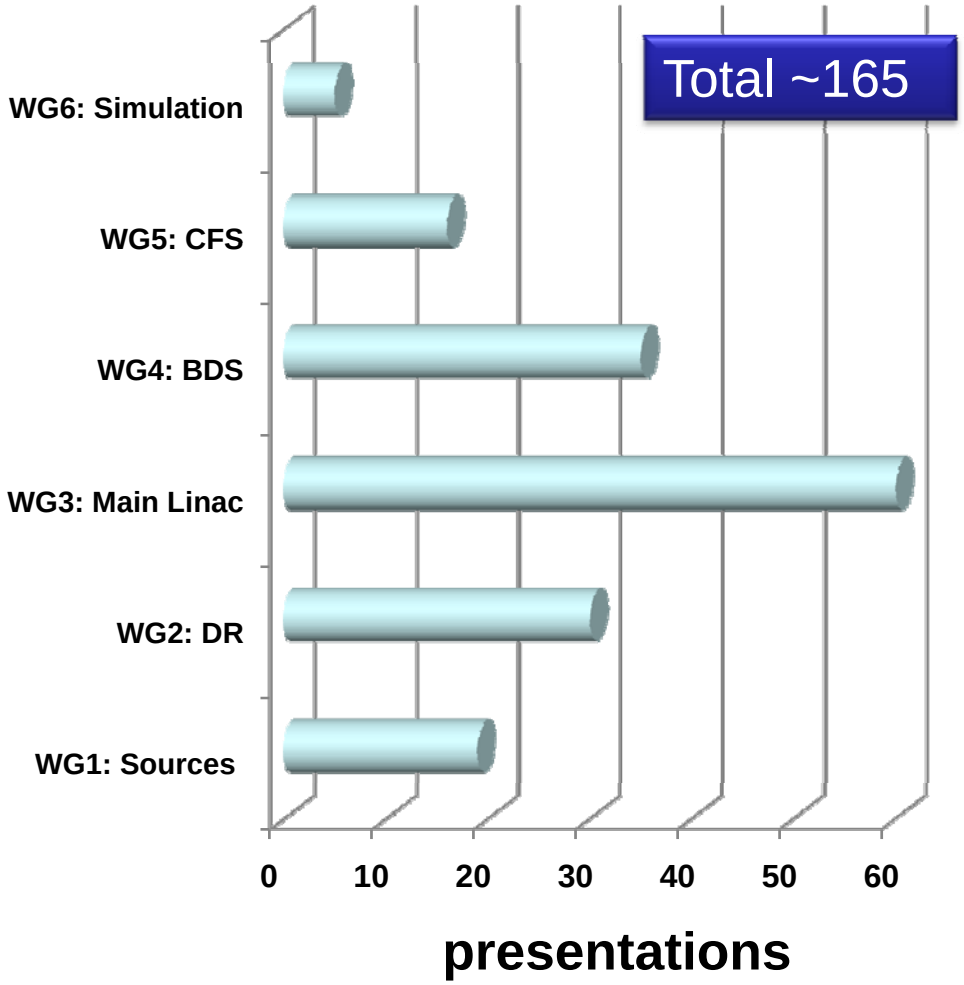

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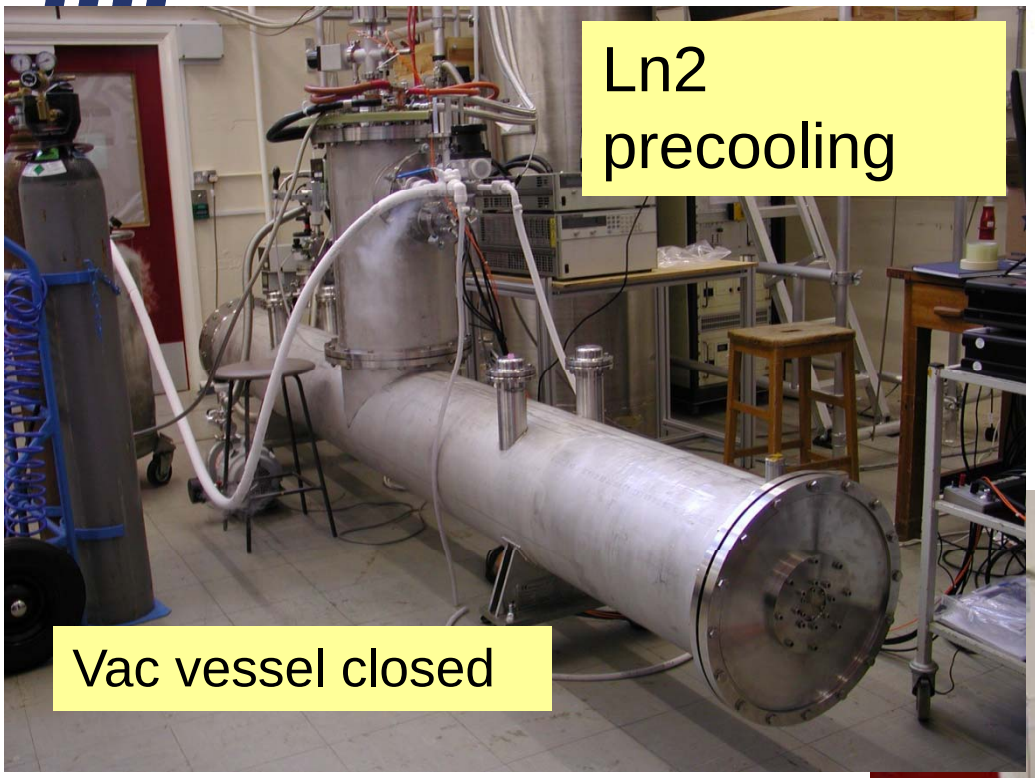
Positron source: First Ever Full Length Undulator Cryomodule



Constructed by Rutherford Appleton Lab.

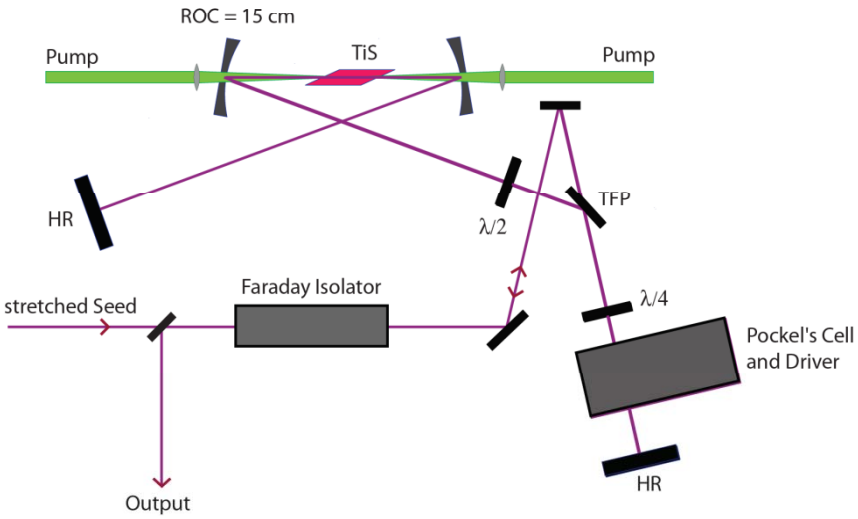
First cooldown of complete system early Sept 08.

Vertical magnet tests successful – design field exceeded in both 1.75m undulators

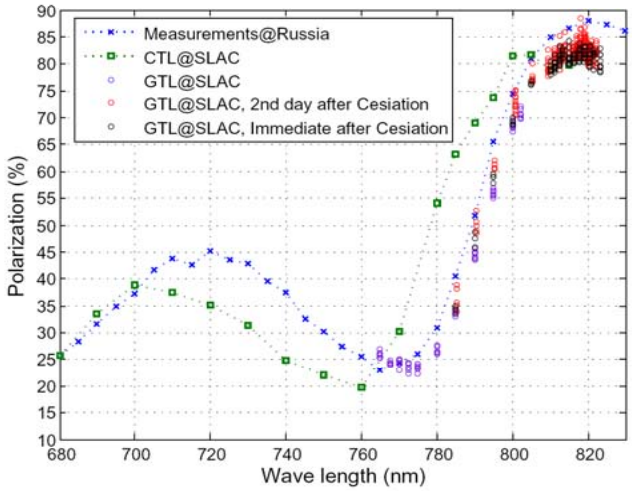
But, vacuum leak when cold – now being repaired – should be complete by Jan 09

Electron source R&D towards Bunch-Train Generation

Source Laser Development



Photocathode R&D



Gun Development

[Proof of principle of ILC bunch train generation is anticipated within ~ 2 years.]

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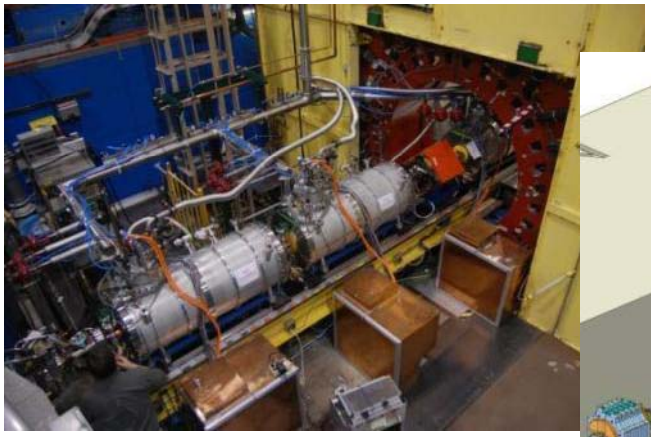
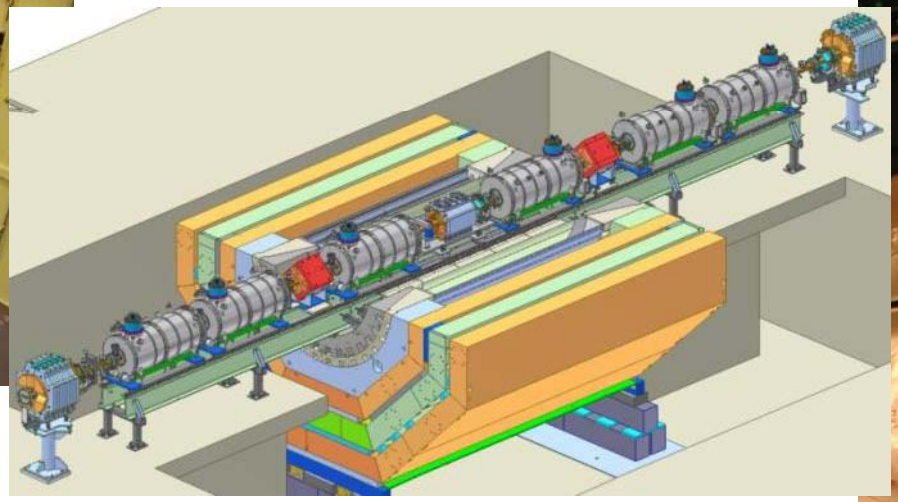
Damping Rings Critical R&D

- Electron cloud.
  - Goal is to demonstrate effective mitigation methods.
  - Studies are in progress at CesrTA, DAΦNE, KEKB.
- Fast injection/extraction kickers.
  - Goal is to demonstrate fast, high-power pulsers meeting ILC damping rings specifications.
  - Studies are in progress at ATF, DAΦNE, SLAC.
- Low-emittance tuning.
  - Goal is to demonstrate reliable operation with 2 pm vertical emittance.
  - Swiss Light Source has recently achieved 3 pm.
  - Studies are in progress at ATF and CesrTA.

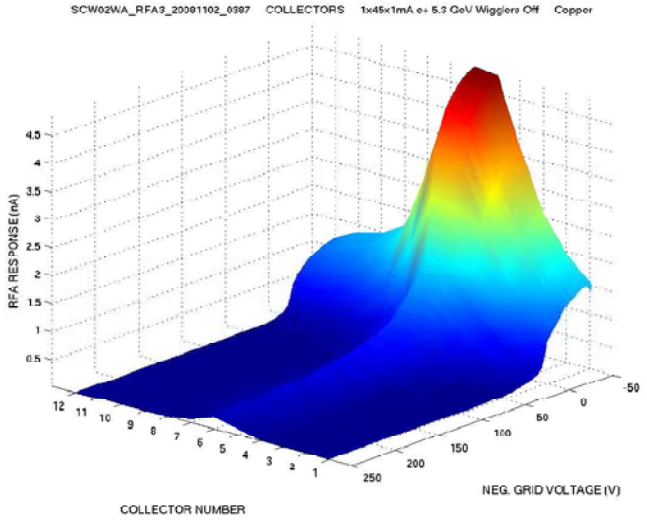
Electron Cloud Studies in CesrTA





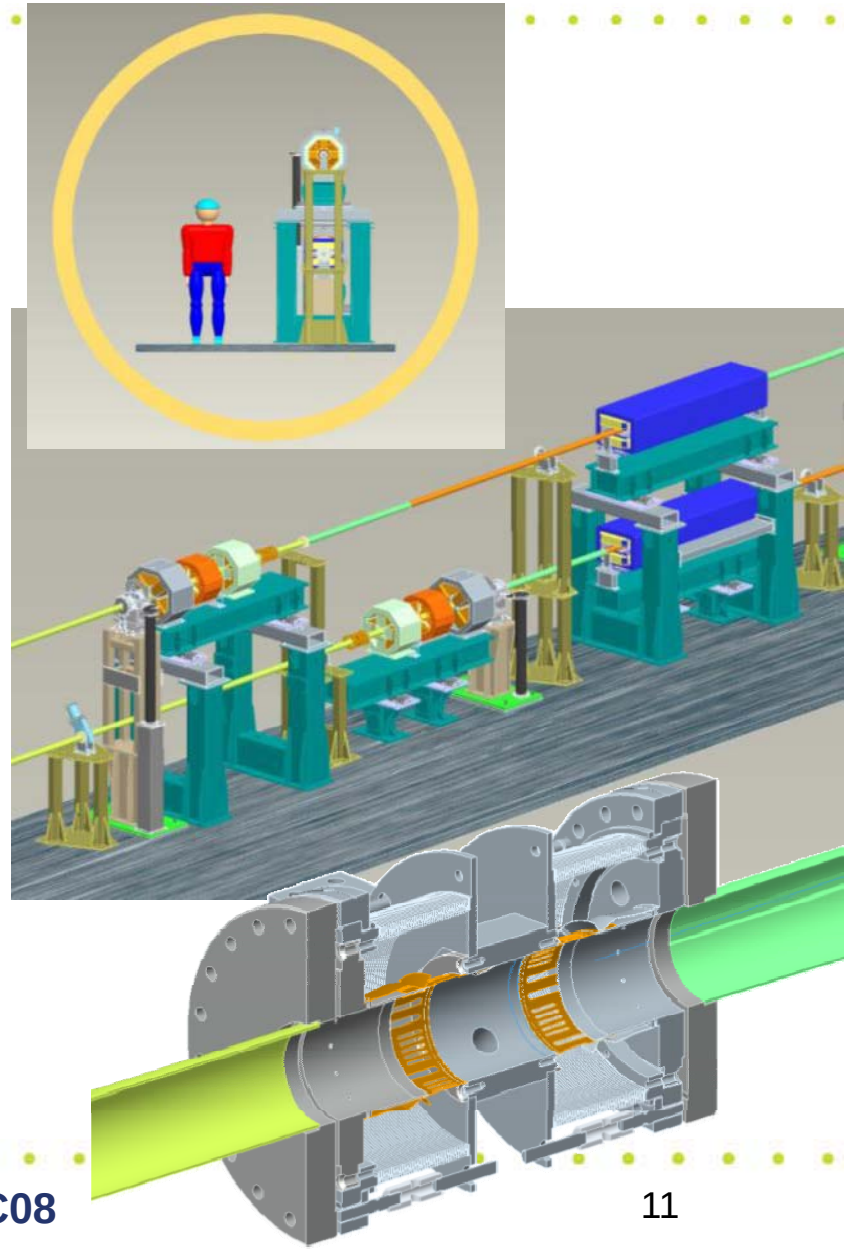
Installation of wigglers in former location of CLEO (above).

Retarding field analyzers in wiggler vacuum chambers, and first data (right).



Design/Costing/Minimum Machine

- Technical design work is in progress to:
  - find optimum solutions for engineering issues;
  - provide a firm basis for value engineering and a revised cost estimate;
  - provide essential information for beam dynamics and performance studies.
- Results from design and costing studies will be applied to understand benefits/risks and cost savings of 3 km rings allowed by low-power option.



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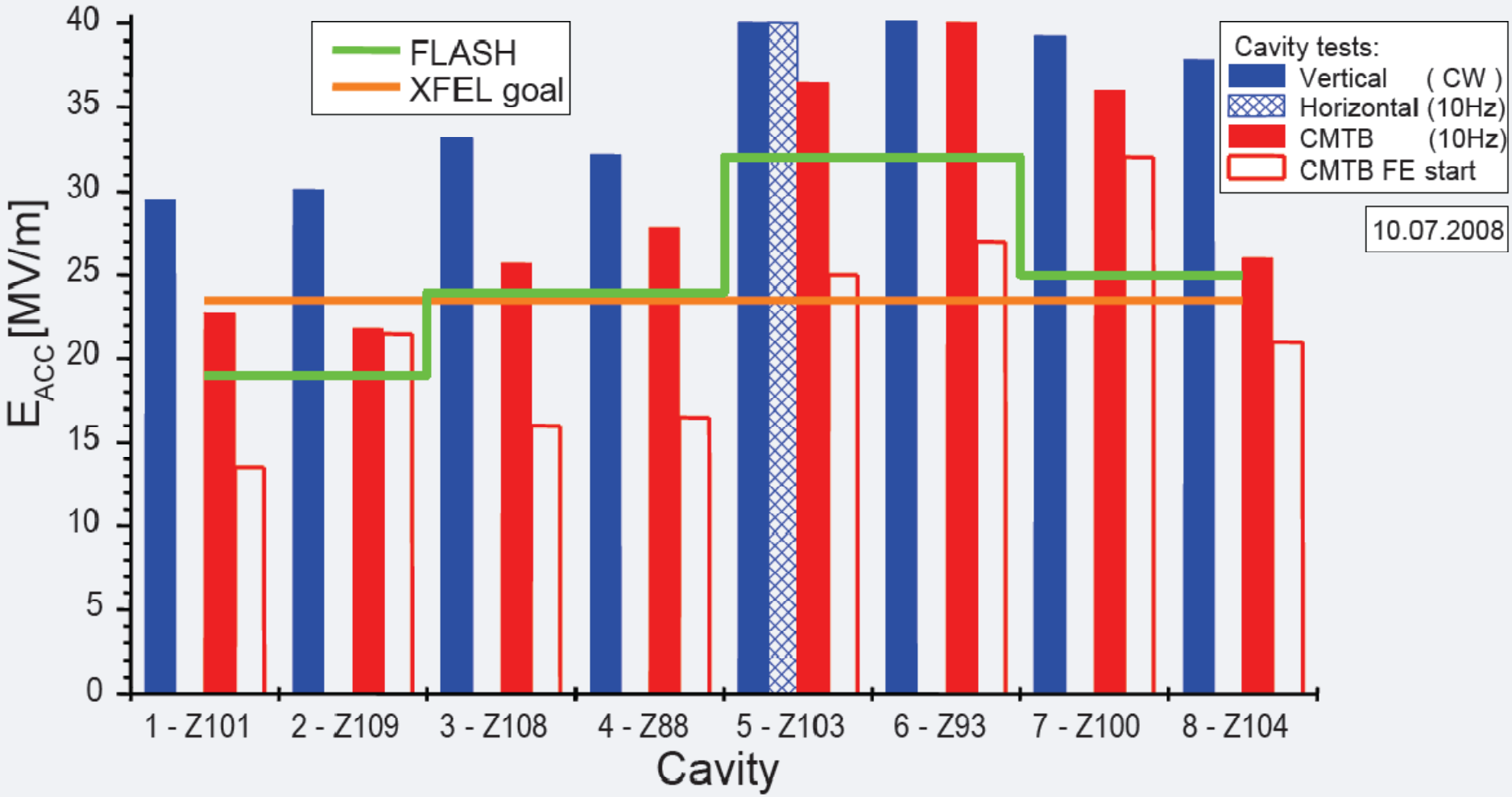
SCRF: Highlight

- S0: High Gradient
  - **Yield > 20 % at 35 MV/m (overall)**
  - **Yield > 50 % at 35 MV/m (one vender)**
- S1: Cavity-string
  - **CM-8 at DESY: Eacc-max = ~ 40 MV/m**
  - **Cryo-A (half) at KEK: Eacc-max = 32 MV/m**
- Plug-compatibility of cavity and cryomodule:
  - **Cavity plug-compatible conditions nearly fixed,**
  - **Cryomodule plug-compatibility as well,**
- HLRF
  - **Cluster RF design proposed for Min. Machine (SLAC)**
  - **Individual RF source design also proposed (KEK)**
- ML Integration
  - **Quadrupole position stability ~ 0.5 micron-meter achieved (CIEMAT, SLAC)**
  - **BPM tolerance of < 5 micro-meter achieved (SACLAY)**

S1 Results TTC Highlights

Module #8 test results (DESY)



Combined Yield of Jlab and DESY Tests Reported at TTC (Delhi, Oct. 2008),

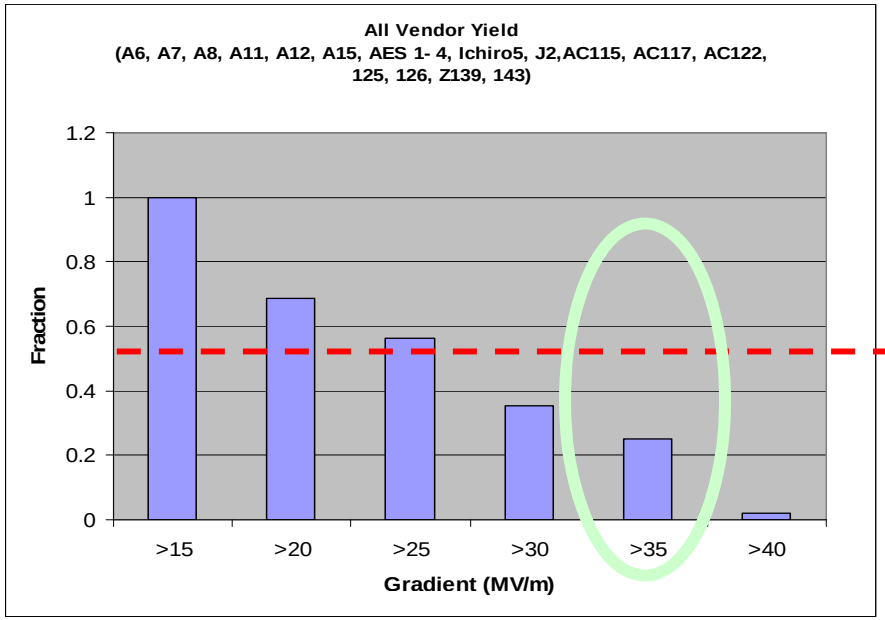
summarized by H. Padamsee

48 Tests, 19 cavities

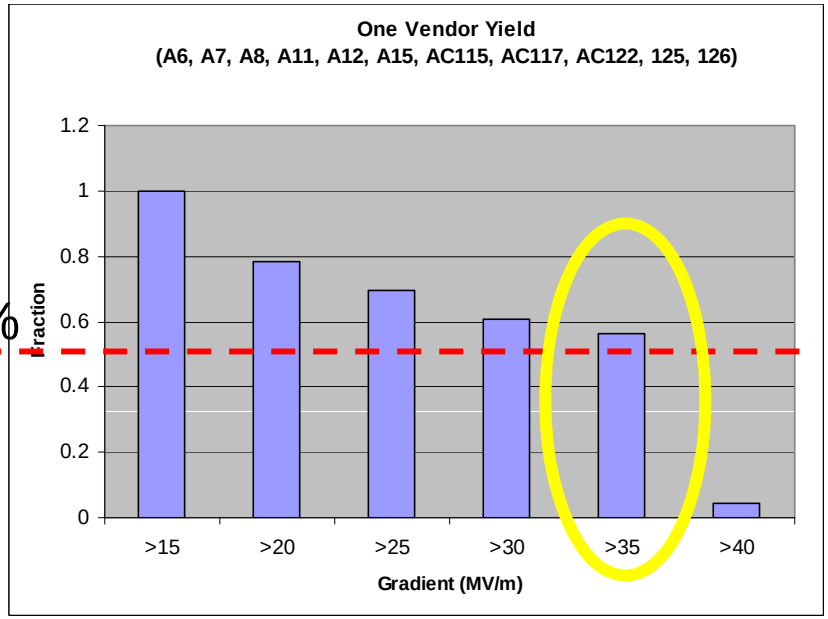
ACCEL, AES, Zanon, Ichiro, Jlab

23 tests, 11 cavities

One Vender



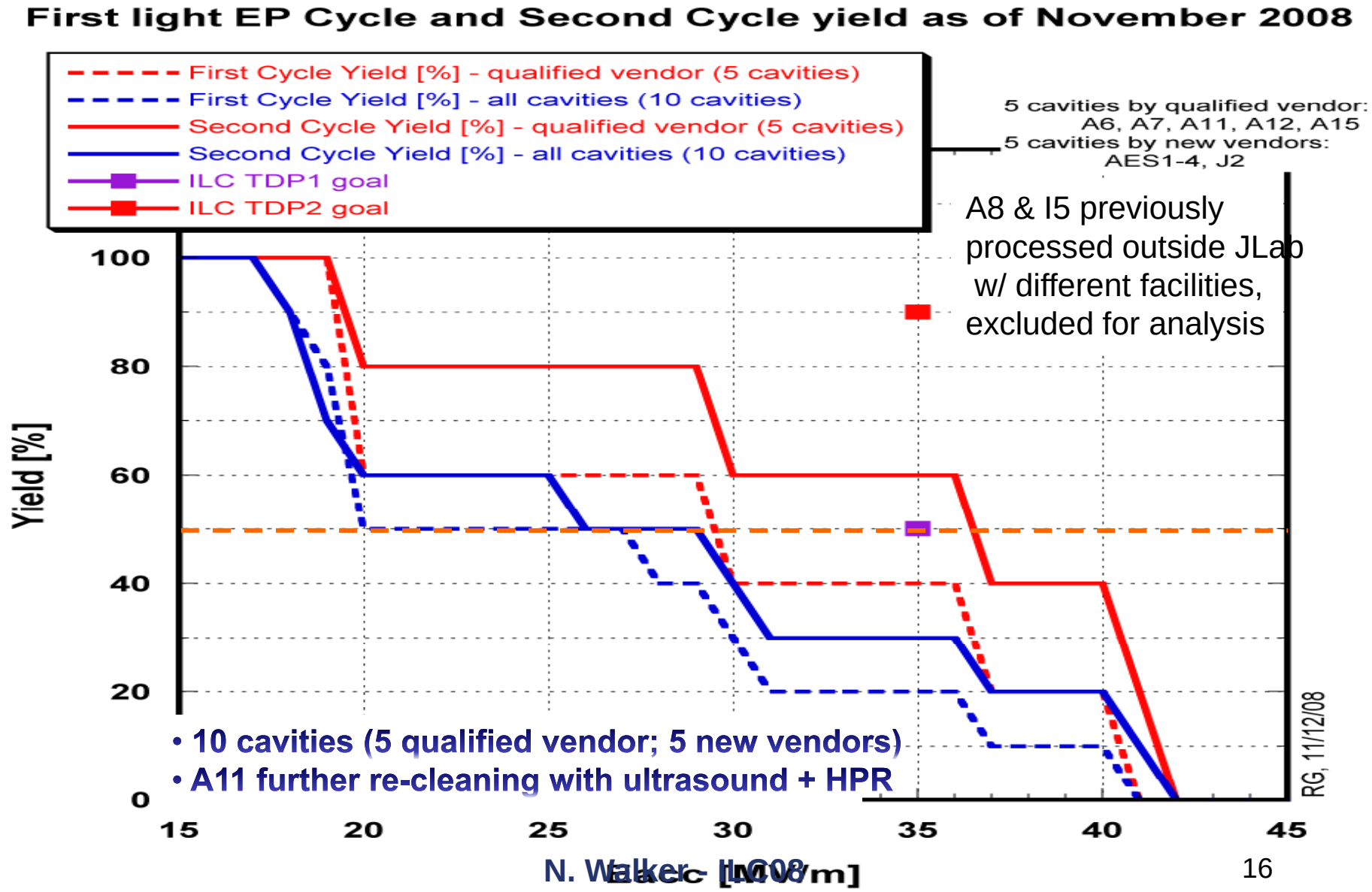
50%



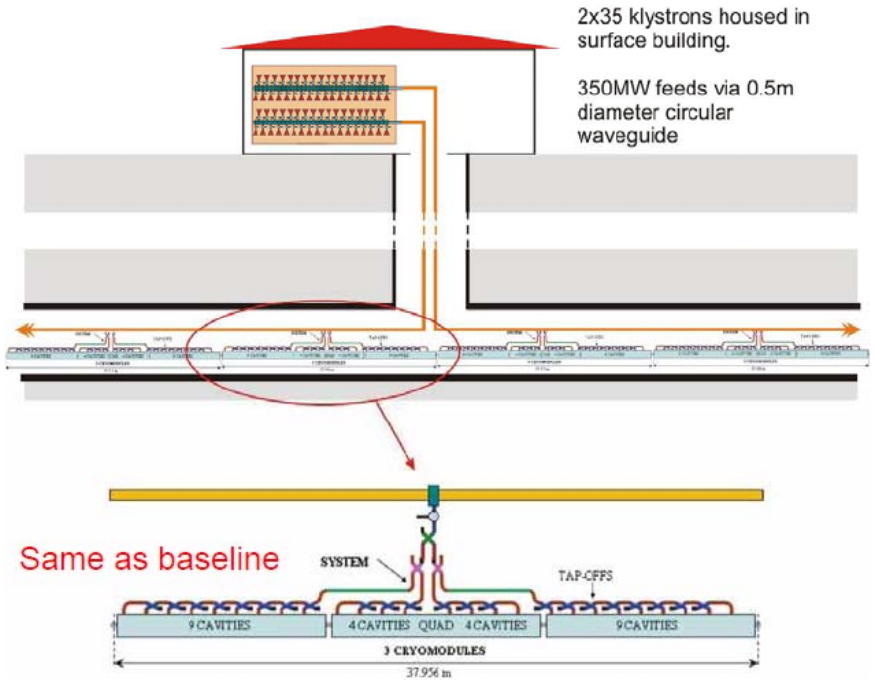
Yield 50 % at 35 MV/m being achieved by cavities with a qualified vender !!

Yield Curve – 1st pass and 2nd pass

summarized by R. Geng

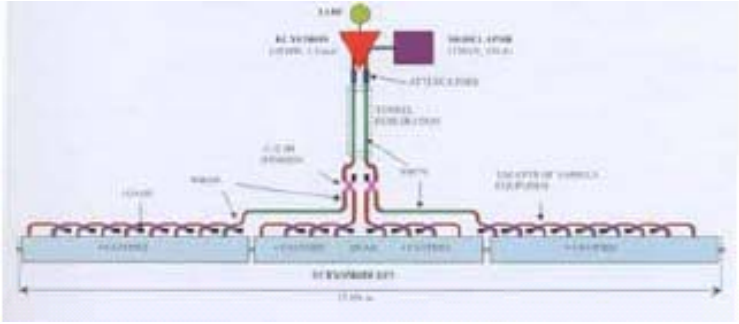


Cost Reduced RF Concepts

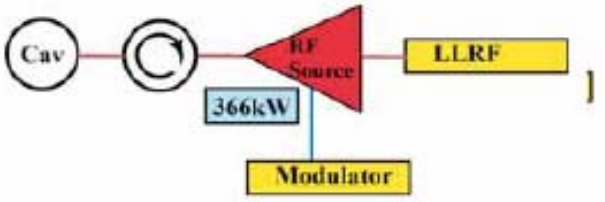


Surface Klystron Cluster (Adolphsen, Nantista, SLAC)

Both options aimed at single-tunnel solutions



Distributed RF Source Concept (Fukuda, KEK)



Total amount

X 26 X 650 =16900

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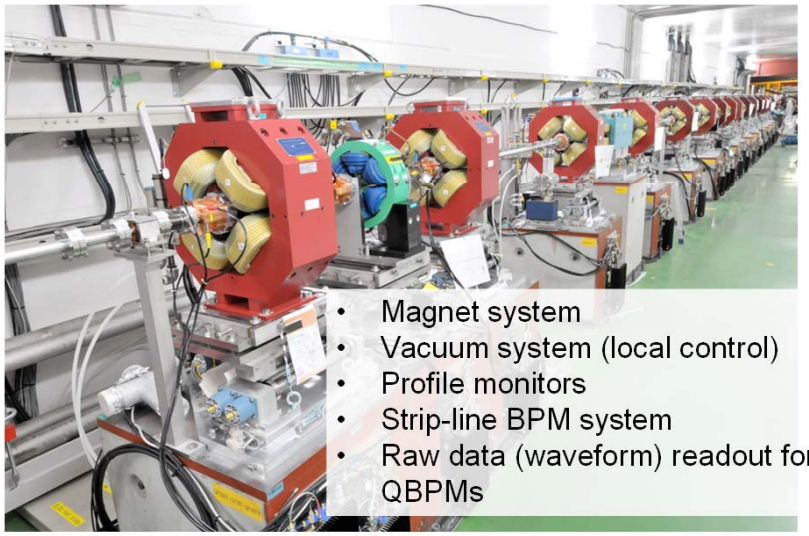
Summary: BDS progress

- ATF2
  - **constructed, hardware mostly commissioned**
  - **Next: beam commissioning**
  - **Developing long-terms plans for AFT2**
    - **SC FD**
    - **squeezed beta* tests, etc**
- IR integration (MDI)
  - **have a new version of "IR Interface Document"**
  - **the document is focused on functional requirements**
  - **MDI and DDI (Detector-Detector Interface)**
  - **Also a lot of progress on detailed Detector and MDI design**

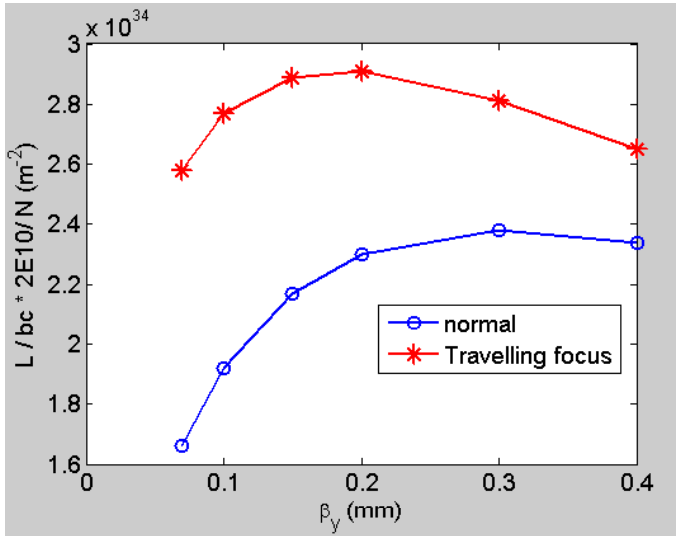
Finished works for ATF2 beamline

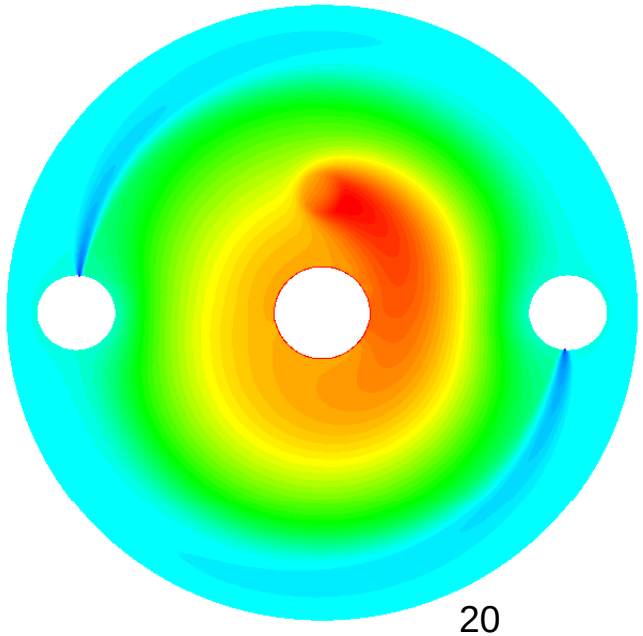


- Magnet system
- Vacuum system (local control)
- Profile monitors
- Strip-line BPM system
- Raw data (waveform) readout for QBPMs

Summary: BDS progress

- Minimal machine studies
  - developing new low-power parameter set
  - will study optics, layout & interferences in "minimum machine"
- Reviewed great progress & discussed further plans in
  - Crab cavity work
    - **demonstrated 0.13deg phase stability, only x2 from ILC reqs, and know how to improve further**
  - Beam dump work
    - **Collaboration BARC-SLAC makes great progress**
  - Collimation
    - **Focus on beam damage tests in near future**
  - Instrumentation
    - **focus on ATF2 and selected critical instrumentation**





Summary: BDS progress

- With $\gamma\gamma$ WG
  - reviewed $\gamma\gamma$ r&d progress
  - outlined next steps for
    - **studies of extraction lines**
    - **lasers and FEL configuration**
    - **Upstream and IR layout**

- Polarization discussion
  - Discussed the list of interferences of existing design
  - Will be looking for design adjustments to minimize interference in most efficient way

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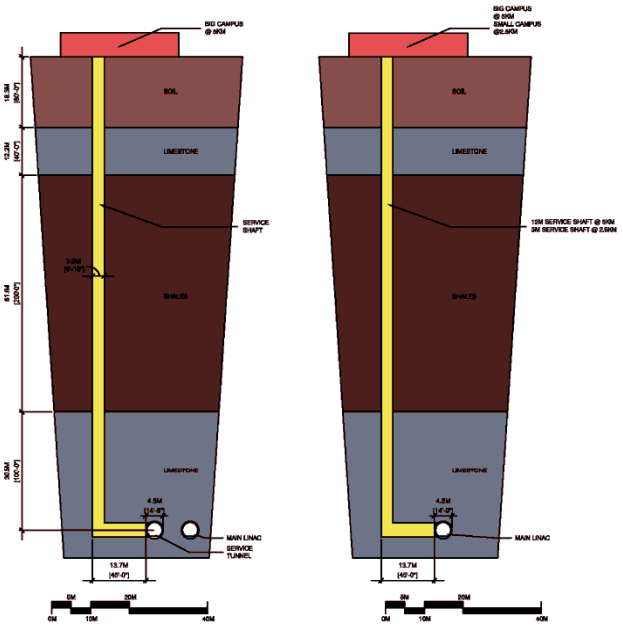
CFS Parallel Session Topics

- Process Cooling Water and HVAC Review
- Klystron Cluster Design
- CLIC/ILC Collaboration and DESY (XFEL) - ILC meeting Planning
- Minimum Machine Design
- Alternate Site and Tunnel Configuration

VALUE Engineering for Processed Water Comparison

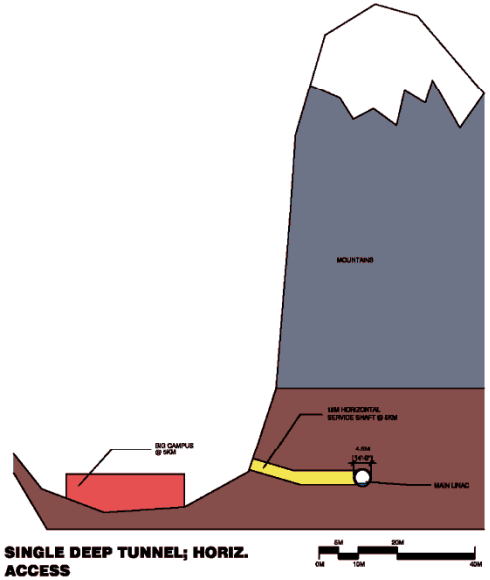
RF Water Delta T		25C DT (45F DT)									40C DT (72F DT)								Kly Cluster-Aug 2008
Impact / Issues (by others)		Scheme 5			Scheme 6			Scheme 7			Scheme 5			Scheme 6			Scheme 7		
Cost to be added (could be by others?)																			
Major IMPACT/ Issues?																			
SS=Sch 10 304 Stainless in Tunnel only ; CPVC=Sch 80 CPVC plastic pipe; CS= Std Sch (40) Carbon Steel		SS	CPVC	CS	SS	CPVC	CS	SS	CPVC	CS	SS	CPVC	CS	SS	CPVC	CS	SS		SS
Overall Water Delta T	°DC	16.7			16.5			18.1			20.3			19.6			22.4		22.1
	°DF	30.1			29.7			32.6			36.5			35.2			40.4		39.8
"First-Cost" Savings in % - Process/Air Treatment WBS 1.7.3. & 1.7.5		28%	30%	31%	23%	25%	26%	30%	32%	33%	31%	33%	32%	26%	28%	27%	35%		-47%
RF Loads and Circulators reduced flow																			
RF Modltrs and Plse Transfm-flow/temp																			
Watercooled wvgde cooling design (by others)																			
Kly Clstr's RF Pipe Cooling by others																			
High Space Temperature ok?		~45°C (113°F)									~45°C (113°F)								
Equipment Insulations??																			
50% reduction in air heat load possible?																			
Finalize HLRF Heat Load table? Collector issue?																			
Rack chiller impact ok? / Rework rack arrngmt??																			
Confirm reduced Heat load from racks?																			
Cost for increased maintenance due high space																			
Cost of portable cooling for maintenance																			
Pump Recirc loop at Collector~ $2M??																			
Pump Recircloop (modul/P.Transfmr)~ $2M ??																			
Electrical Reduction		~ (- 2.3 MW)									~ (- 2.3 MW)								
Operational cost reduction		~ (- ??)									~ (- ??)								
Electrical addition					~ + 3 MW			~ + 1 MW						~ + 3 MW			~ + 1 MW		??
Operational cost addition					+ ??			+ ??						+ ??			+ ??		
Pipe Press & Temp limit issues																			
"Clean Water" Compatibility Issue																			

Deep & Shallow Site Solutions

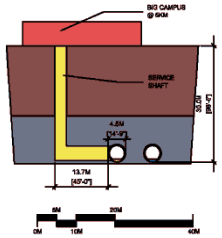


TWIN DEEP TUNNELS; VERTICAL ACCESS

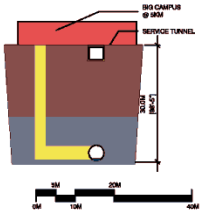
SINGLE DEEP TUNNEL; VERTICAL ACCESS



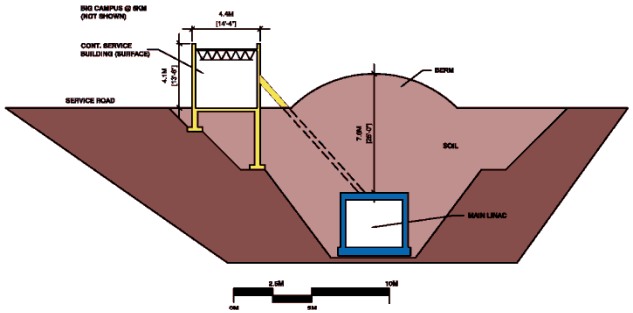
SINGLE DEEP TUNNEL; HORIZ. ACCESS



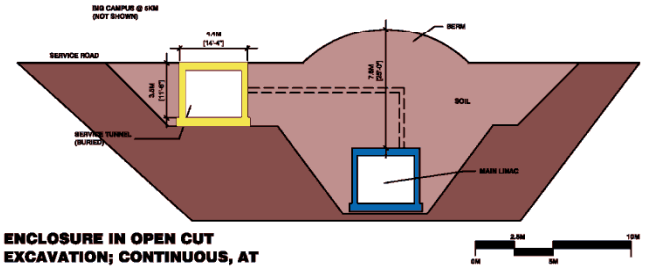
TWIN NEAR SURFACE TUNNELS



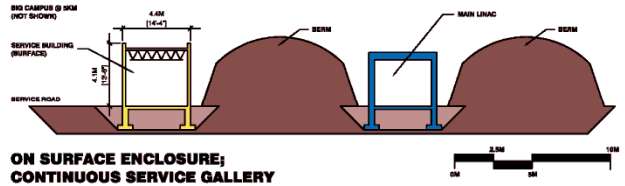
SINGLE NEAR SURFACE TUNNEL W/ CONTINUOUS, AT SURFACE, SERVICE ENCLOSURE



ENCLOSURE IN OPEN CUT EXCAVATION; CONTINUOUS SERVICE GALLERY



ENCLOSURE IN OPEN CUT EXCAVATION; CONTINUOUS, AT SURFACE, SERVICE ENCLOSURE



ON SURFACE ENCLOSURE; CONTINUOUS SERVICE GALLERY

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Reported Recent Progress

- Studies of Coupler kicks of SC cavity
  - Field calculations and beam dynamics simulations.
- Survey/Alignment
  - Simplified Survey/Alignment model
  - Simulation of survey/alignment process
  - Tolerances look very tight for conventional methods.
    - **LiCAS offers satisfactory performance.**
- RTML
  - Studies of shorter bunch compressors. (single-stage and two-stage)
  - Design of extraction line,
  - Stray field measurement. Tight tolerance. Need more data.
- Code development (CHEF)
- Luminosity performance studies including feedbacks

Making List of Tolerances

- Establish agreed-upon list of tolerance specs.
  - Most tolerances available; people were assigned if not.
  - First (incomplete) version will be released soon.
  - Experts need to check feasibility of the requirements.
    - **Iterations will be needed, between engineering <-> beam dynamics. (There have been already such process.)**
- Known problems:
  - BPM in Main Linac: We require too tight scale error.
  - Survey/Alignment: No reliable (and simple) model yet.
- Need to check if anything important are missed.

Discussion of future plans (Collaboration with CLIC)

- Action items were listed up
  - Survey/Alignment, temperature stability (DR and BDS), DR beam dynamics, CLIC ML simulation (bench marking), RTML vacuum spec, single stage BC performance, reduction of number of dumps, stray field in return line (measurement), Luminosity measurement simulation, common standards (common lattice deck format, AML), Feedback study (fast and slow), beam dynamics in particle source areas.
  - People are assigned to most of them.
- Manpower resources should be reviewed.
- ILC-CLIC beam dynamics Workshop (2009) is considered. Enough participants?
- Studies for Minimum Machine
  - Study of Single-stage BC on going
- Communication with other groups is important

TD Phase Goals & Objectives for a Global Project

Global R&D Plan

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

- Available from: http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=D0000000*813385
- Release 2 June 2008
- Contains summary of **Global Resources** available for ILC or ILC-related activities.
- Top Level (PM) milestones & Goals
- Due to review / re-release

TD Phase 1 Stated Priorities (R&D Plan)

Risk Mitigating R&D	• SCRF Technology (e.g. gradient) • Damping ring electron cloud • …
Beam Test Facilities	• ATF / ATF 2 (KEK) • CesrTA (Cornell) • TTF/FLASH (DESY)
Machine Design / Cost	• CFS / Value Engineering • “Minimum Machine” concept

Global SCRF Technology

Implicit but critical GDE goal:

Promote development of
1.3GHz nine-cell expertise &
infrastructure
in all three regions

Global SCRF Technology

KEK, Japan

Global SCRF Technology

FNAL, ANL

SLAC

Cornell

JLAB

KEK, Japan

Global SCRF Technology

JLAB

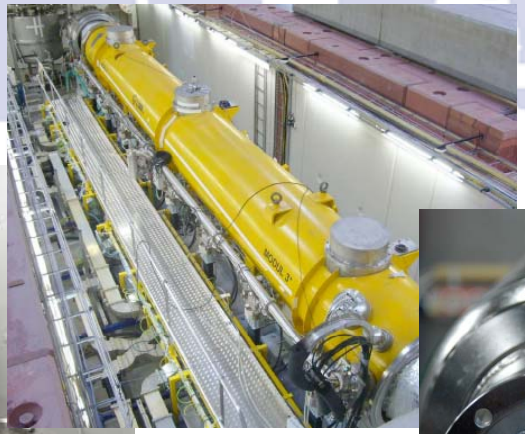
DESY

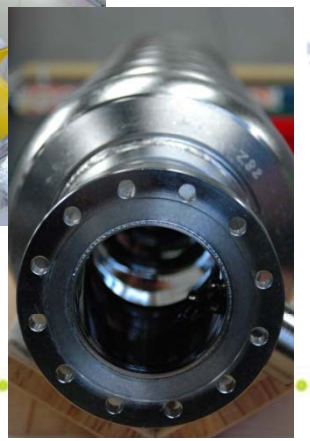
LAL

Saclay

INFN Milan

KEK, Japan

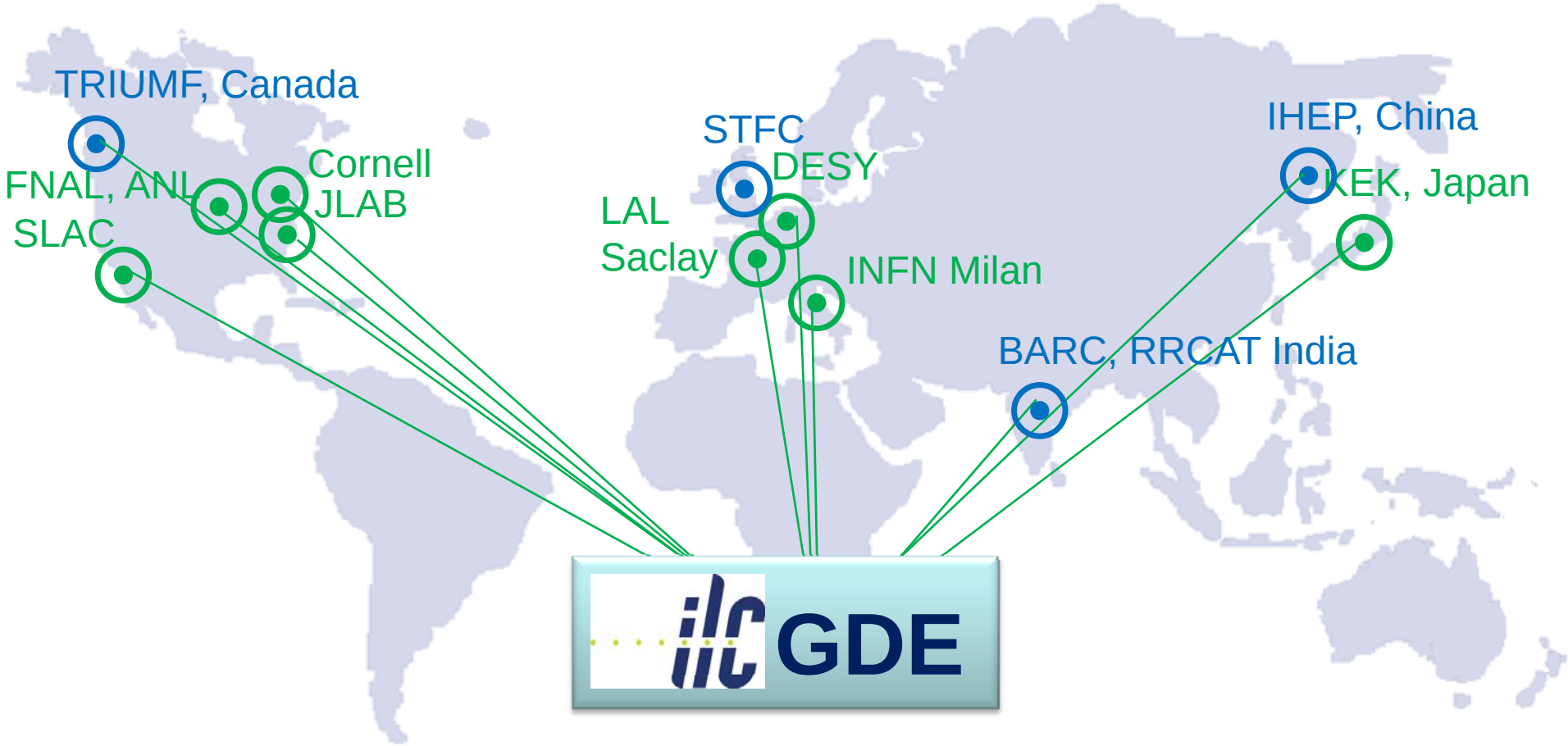




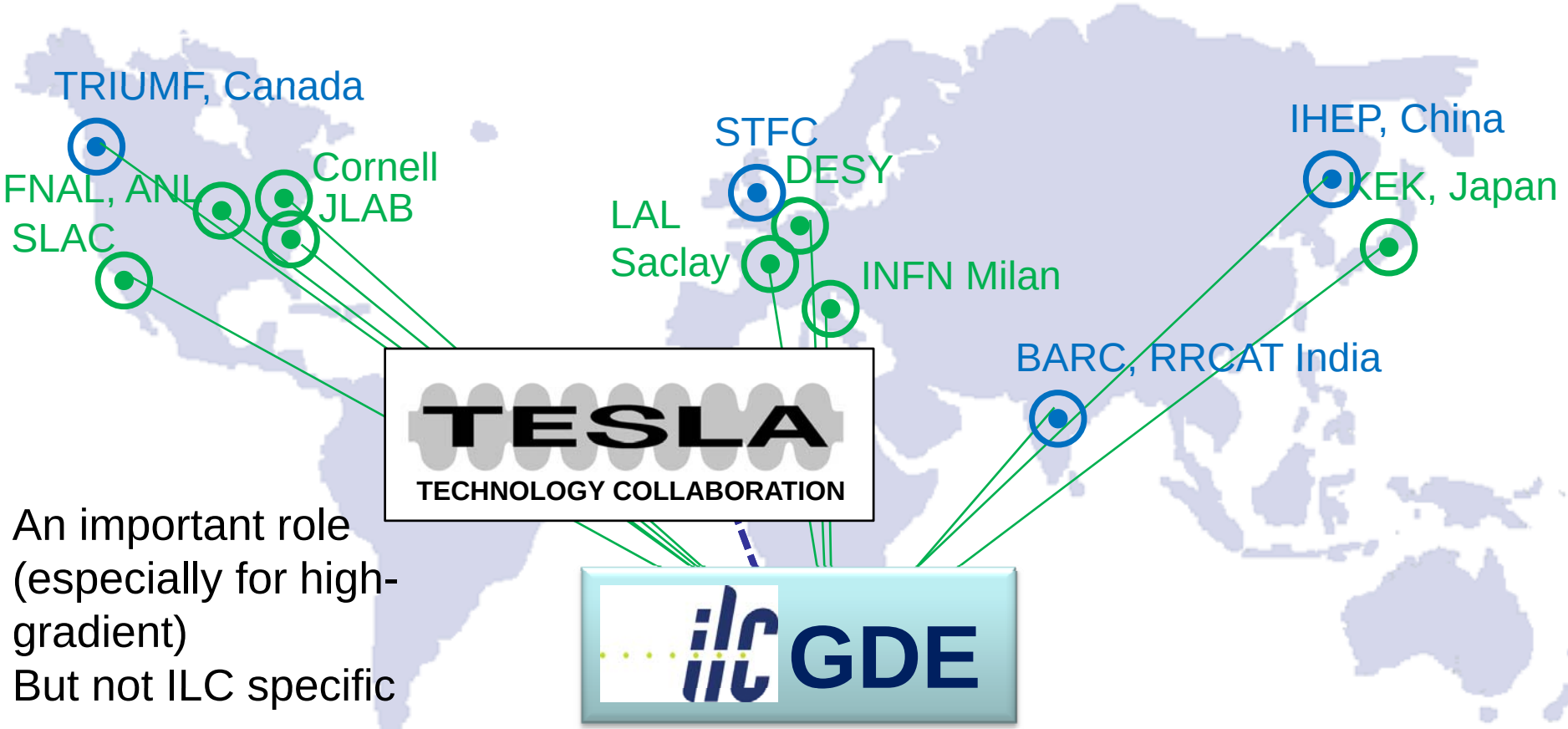
Global SCRF Technology

Emerging SRF

Global SCRF Technology



Global SCRF Technology

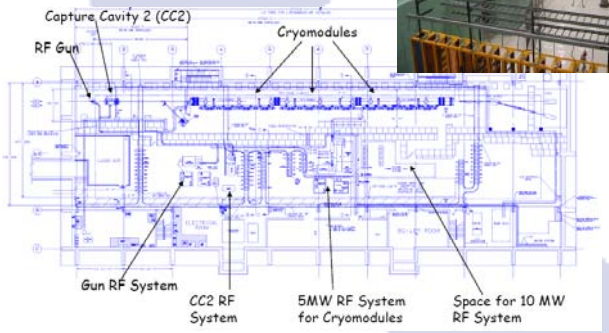


An important role (especially for high-gradient)
But not ILC specific

PMs are thankful for the Technical Guidance given by TTC

SRF Test Facilities

FNAL

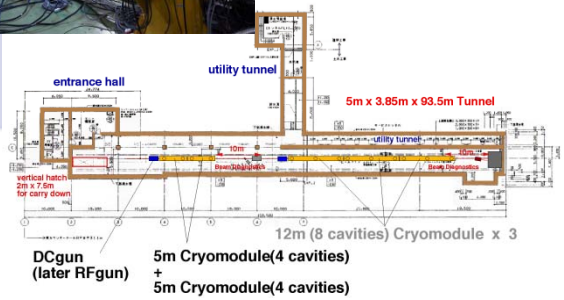


NML facility
Under construction
first beam 2010
ILC RF unit test

DESY

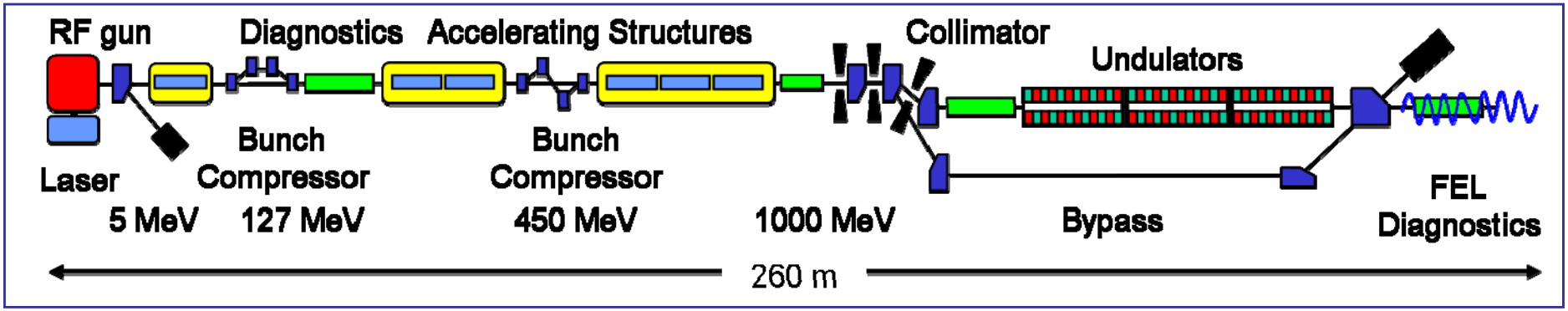
TTF/FLASH
~1 GeV
ILC-like beam
ILC RF unit
(* lower gradient)

KEK, Japan



STF (phase I & II)
Under construction
first beam 2011
ILC RF unit test

TTF/FLASH at DESY

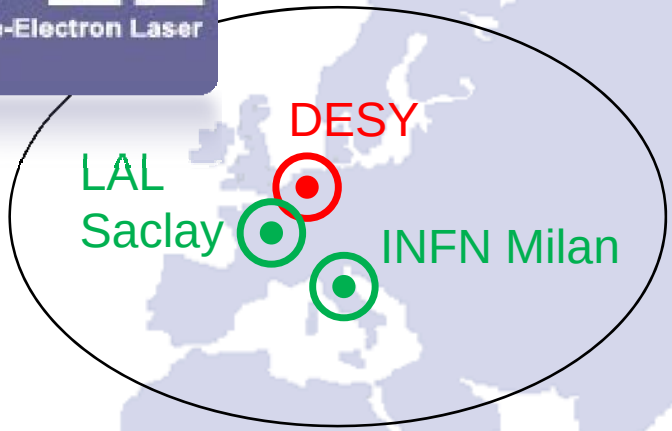


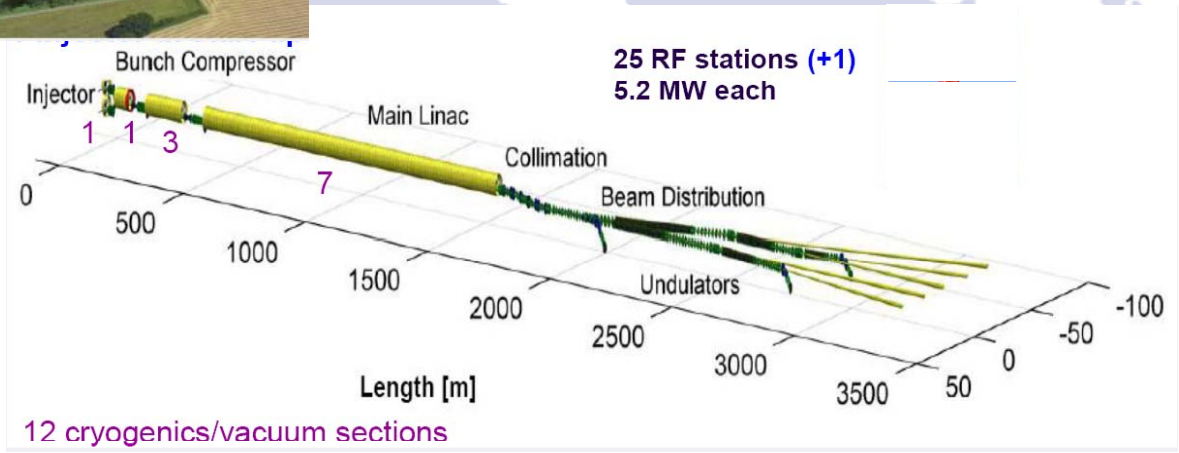
TTF/FLASH: currently a unique facility world-wide

		XFEL X-Ray Free-Electron Laser	ILC	FLASH design	FLASH 9mA 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

European XFEL

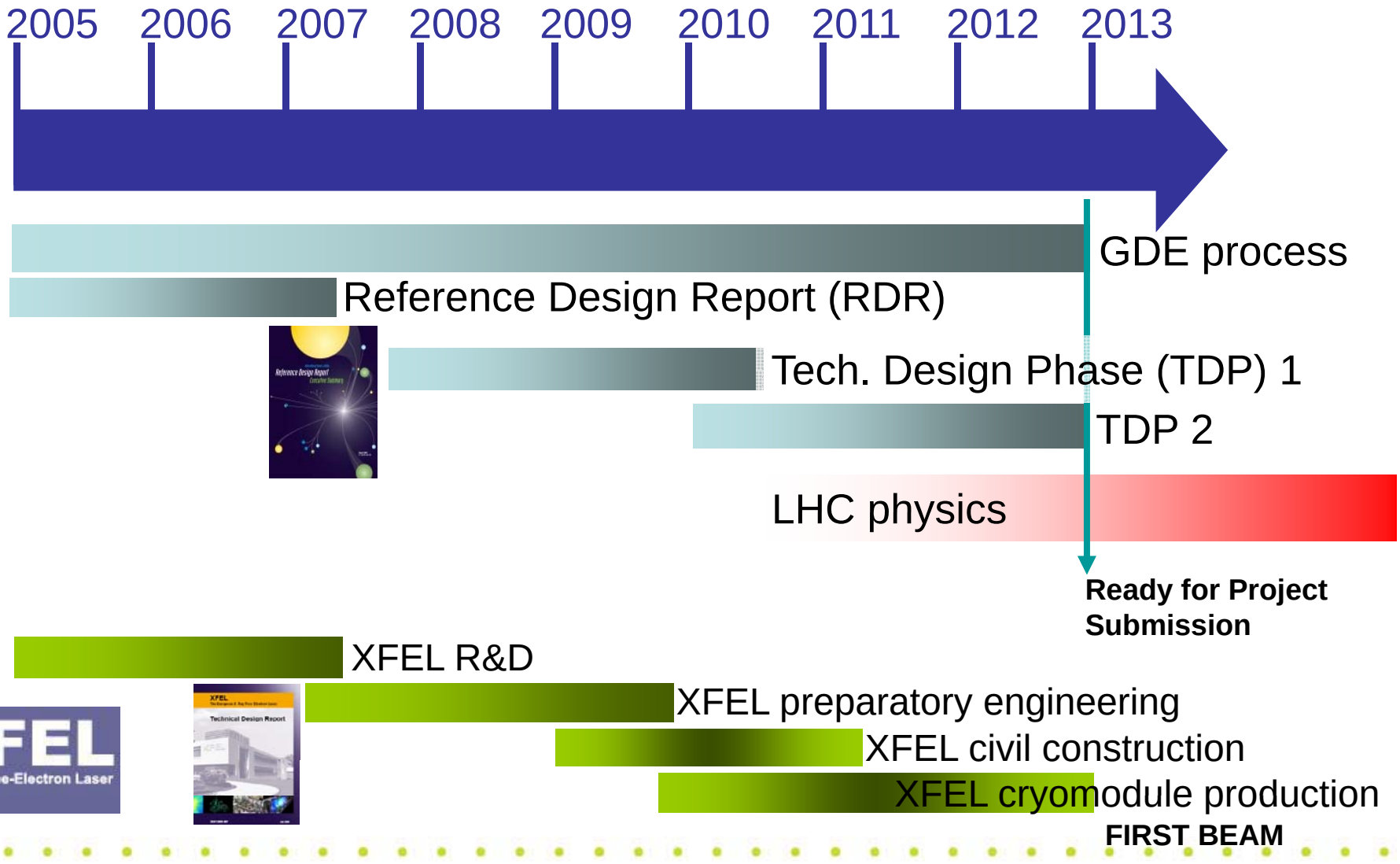
XFEL
X-Ray Free-Electron Laser



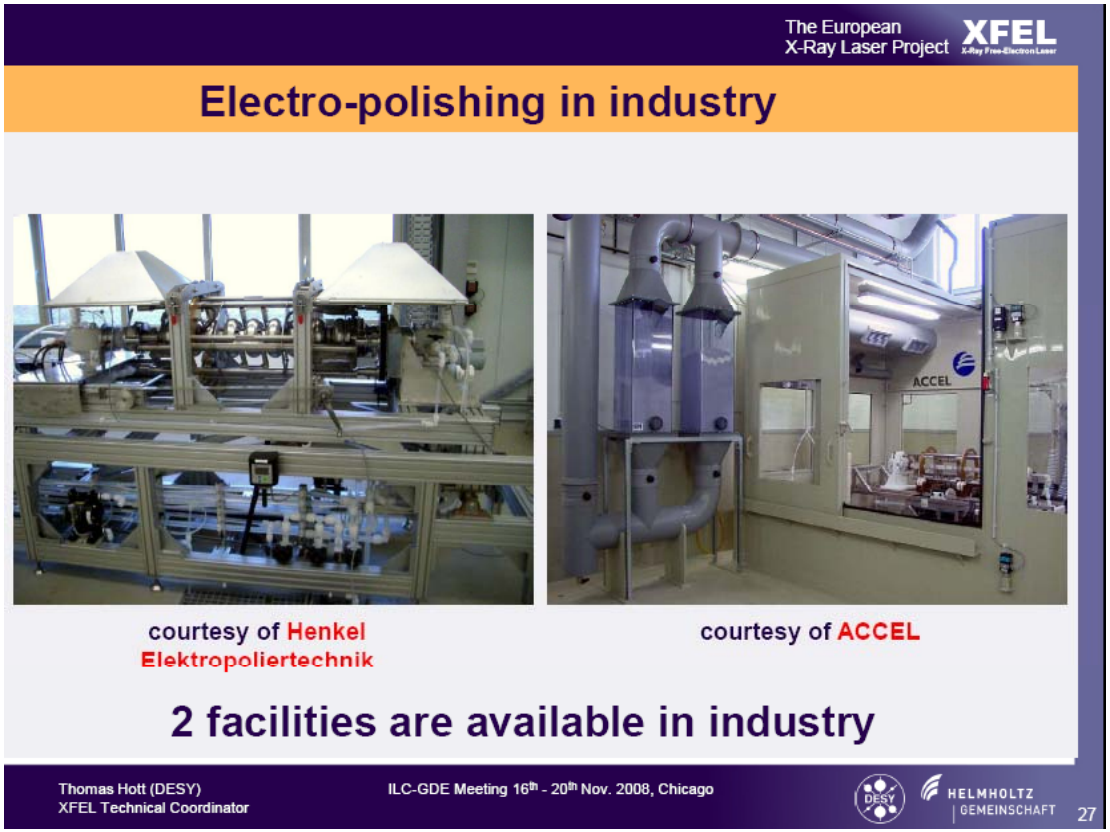


- 101 Cryomodules
- 808 cavities
  - **plus auxiliaries**
- Gradient:
  - **23.5 MV/m**
  - **(28 MV/m)**
- Industrialisation & mass production
  - **1 CM / week**
- "In-kind" international model

GDE & XFEL Timelines

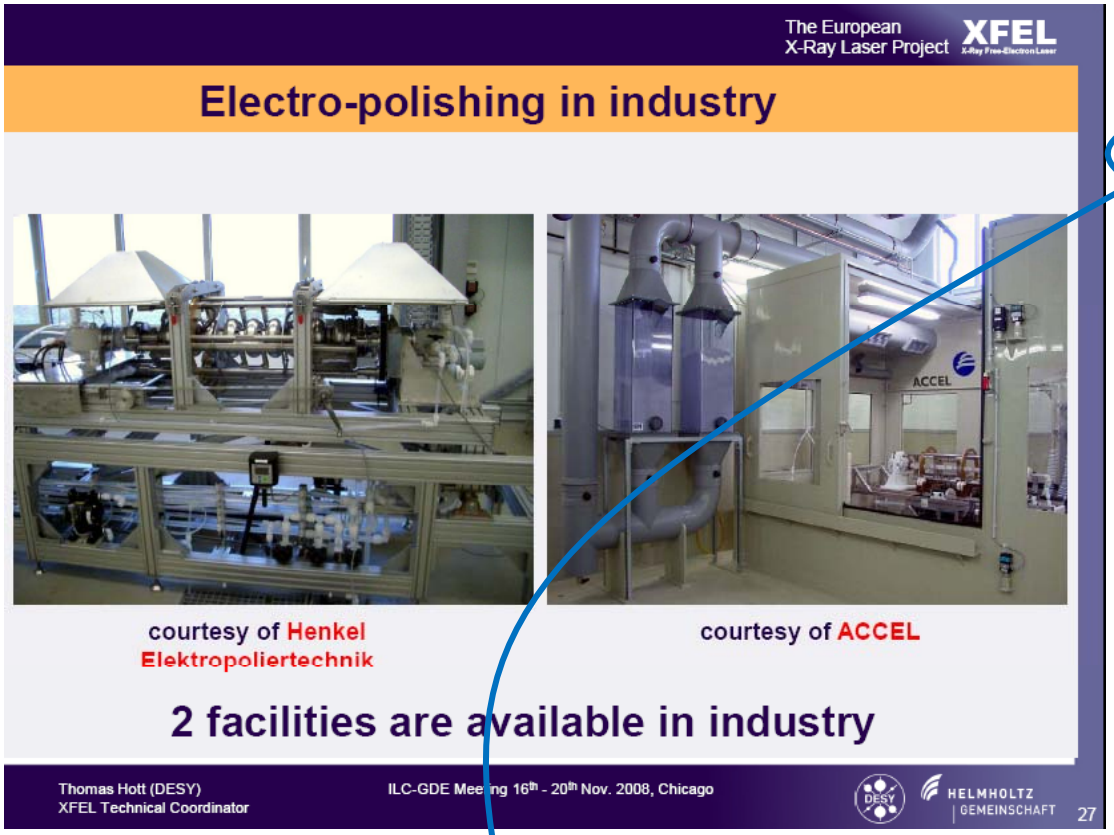


XFEL Cavity Production



- Bulk EP in industry (2)
- Final surface prep. at DESY
- VT at DESY
- Shipped to SACLAY
  - **CM assembly**
- Module transport to DESY
- RF Test at DESY
  - **Module Test Facility**
- **Installation**

XFEL Cavity Production



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- Final surface prep. at DESY
- VT at DESY
- Shipped to SACLAY
  - **CM assembly**
- Module transport to DESY
- RF Test at DESY
  - **Module Test Facility**
- **Installation**

- Final EP with Ethanol Rinse (TBD)
- ILC-HiGrade programme
  - (~26 ILC cavities)

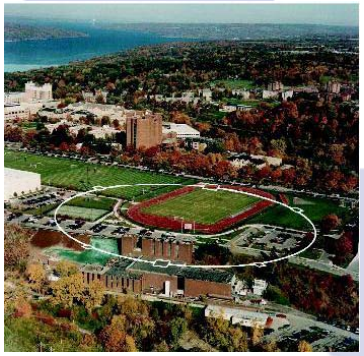
high statistics on ILC-like surface preparation

TD Phase 1 Stated Priorities (R&D Plan)

Risk Mitigating R&D	• SCRF Technology (e.g. gradient) • Damping ring electron cloud • …
Beam Test Facilities	• ATF / ATF 2 (KEK) • CesrTA (Cornell) • TTF/FLASH (DESY)
Machine Design / Cost	• CFS / Value Engineering • “Minimum Machine” concept

(Non-SRF) Beam Test Facilities

Cornell



CesrTA (Cornell)
electron cloud
low emittance

INFN Frascati

DAϕNE (INFN Frascati)
kicker development
electron cloud

ATF & ATF2 (KEK)
ultra-low emittance
Final Focus optics

KEK, Japan

TD Phase 1 Stated Priorities (R&D Plan)

Risk Mitigating R&D	• SCRF Technology (e.g. gradient) • Damping ring electron cloud • …
Beam Test Facilities	• ATF / ATF 2 (KEK) • CesrTA (Cornell) • TTF/FLASH (DESY)
Machine Design / Cost	• CFS / Value Engineering • “Minimum Machine” concept

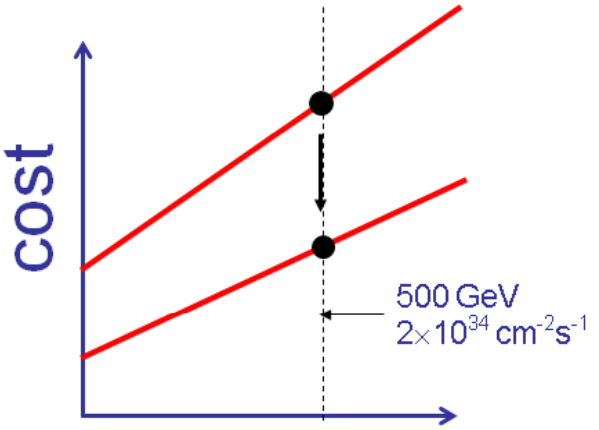
What's in a Name?

- "Minimum" a bad choice of word!
  - historical – now part of the language!
  - does not convey what we are attempting to achieve
- Need a better word!
  - we are really discussing conceptual studies for specific alternative designs
- Will change it soon – but for now…
  - 110 hits on Google!!
- **最も効果的な加速器**

"?????? Machine" Philosophy

- *Direct* performance
  - considered a ph… of merit'
    - centre
    - …
  - …f the …rmance p…
- *Indirec…* …ance
  - into w… we place margi… redundancy, *etc*.
  - tend to impact operational…
  - performance risk
    - potentially affecting inte… luminosity within a given…
- Concentrate on Indirect
  - Do not change basic physics parameters

Global Value Engineering

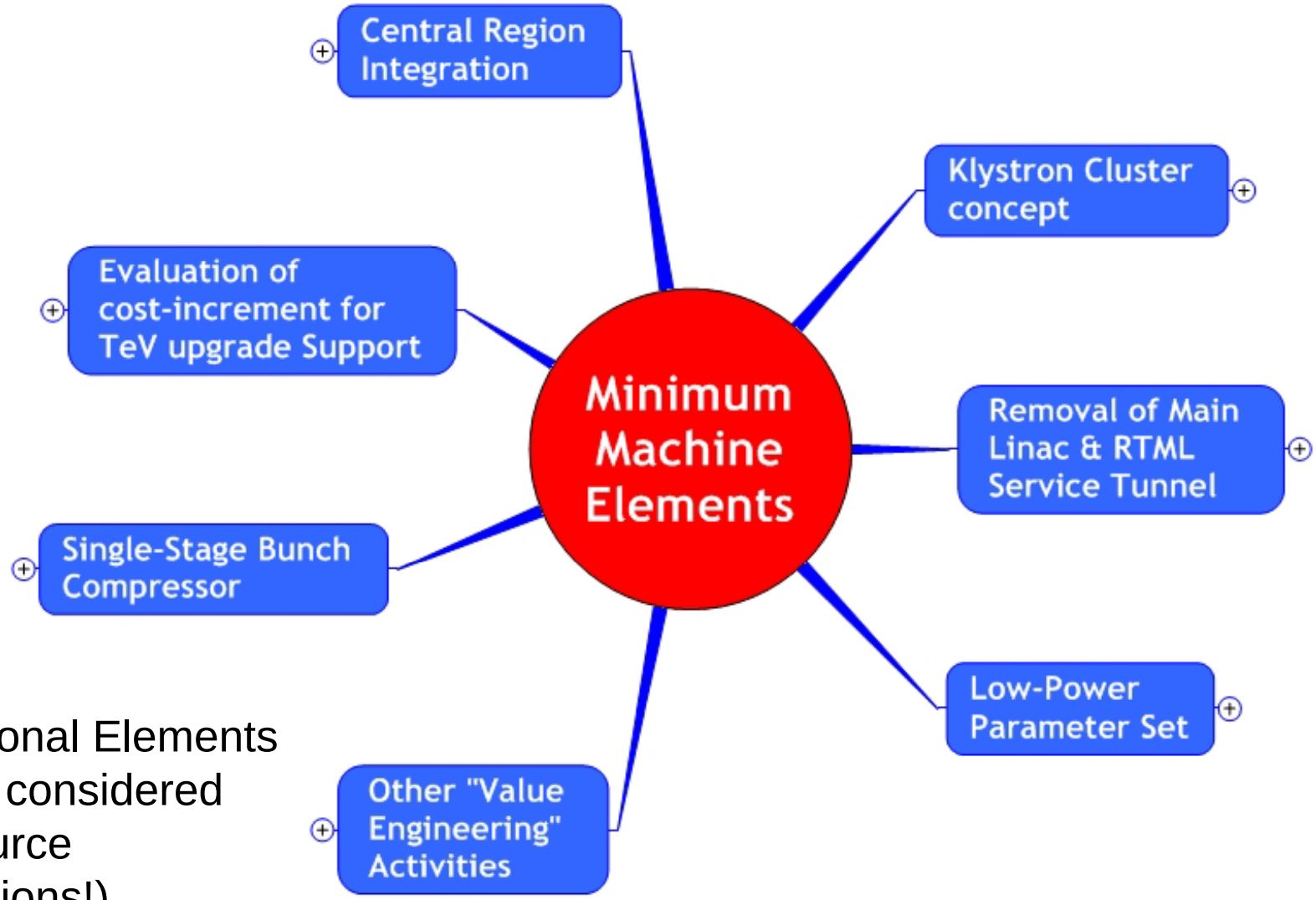


Physics "figure of Merit"
(*direct* performance)

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

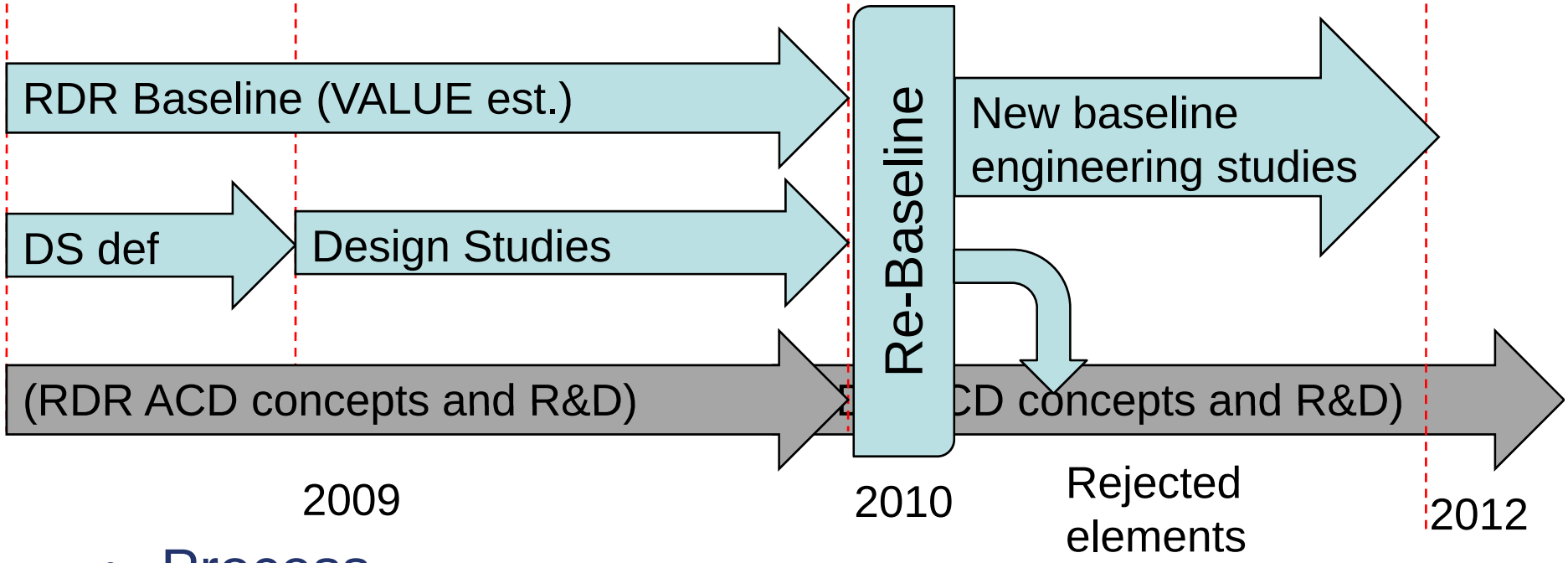
Margin, risk reduction, redundancy, …
(*indirect* performance)

Identified Design Study Elements



Additional Elements being considered (resource limitations!)

Towards a Re-Baselining in 2010



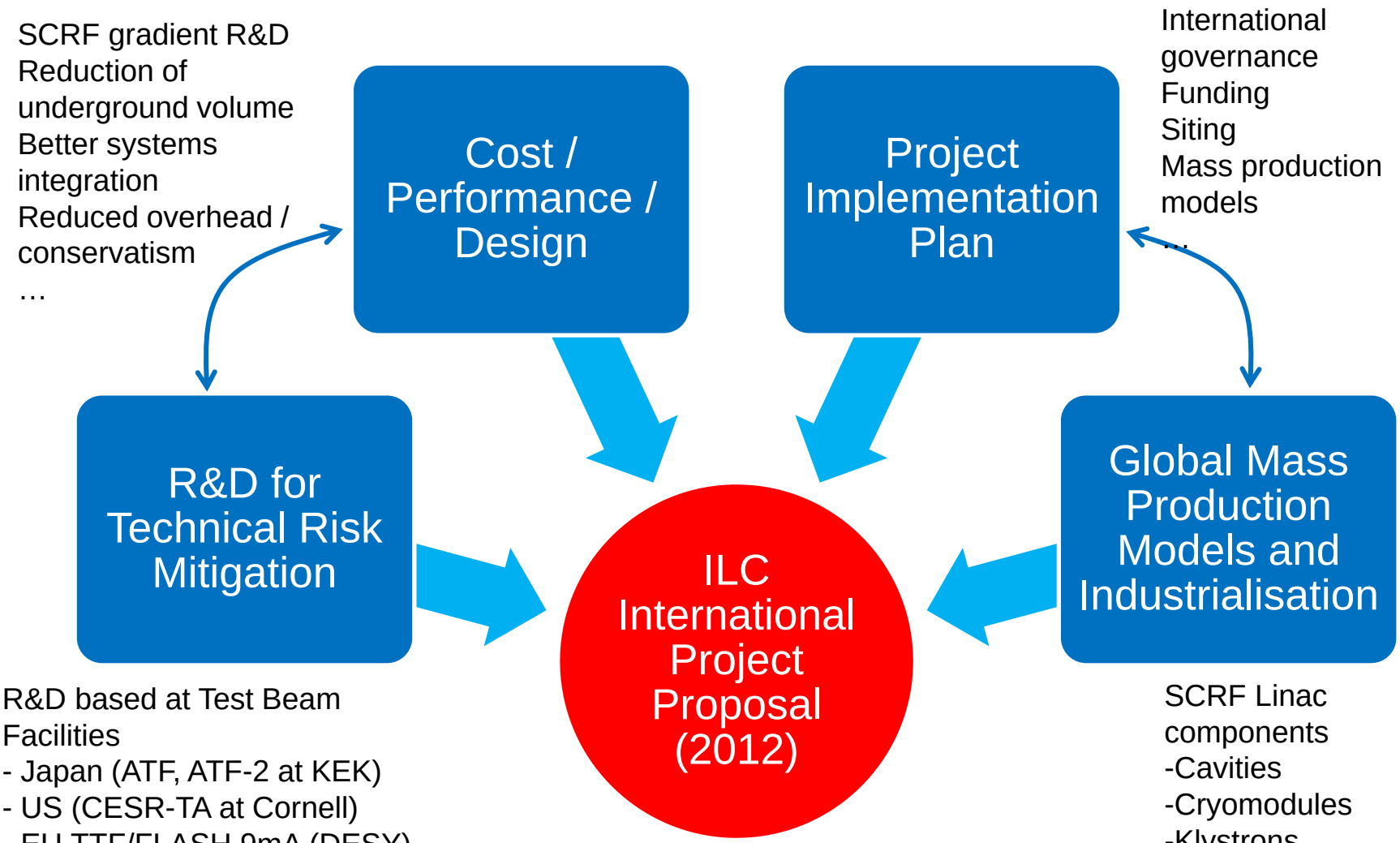
- Process
  - RDR baseline & VALUE element are maintained
    - **Formal baseline**
  - Formal review and re-baseline process beginning of 2010
    - **Exact process needs definition**
    - **Community sign-off mandatory**

Minimum Machine Document in Preparation

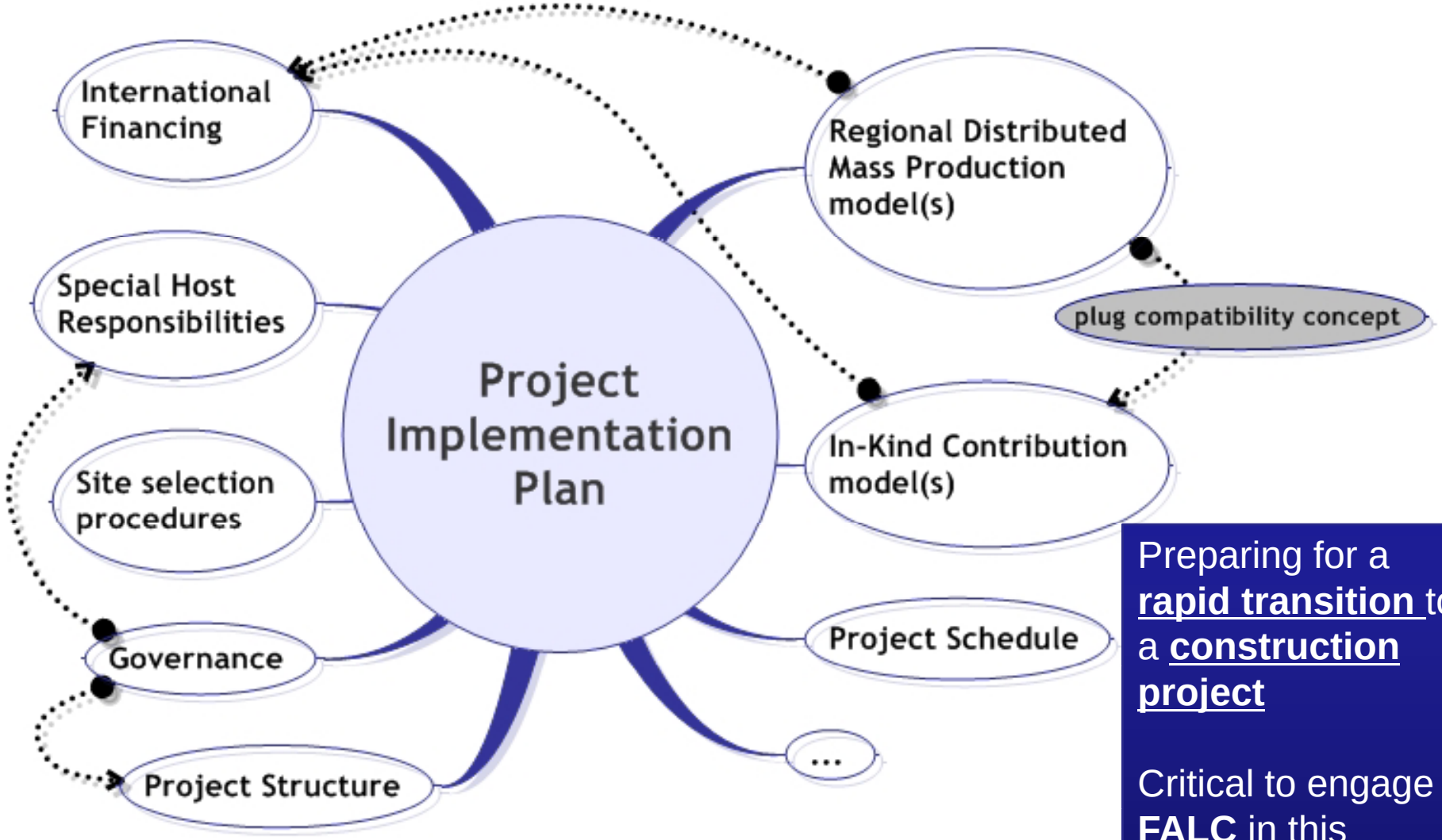
- Draft document is preparation
- (One) Focus of ILC08 workshop
  - Study planning
  - Resources
- Final publication end of year

To communicate our ideas to the broader community and form a blue-print for studies in 09

TD Phase Priorities – A Summary



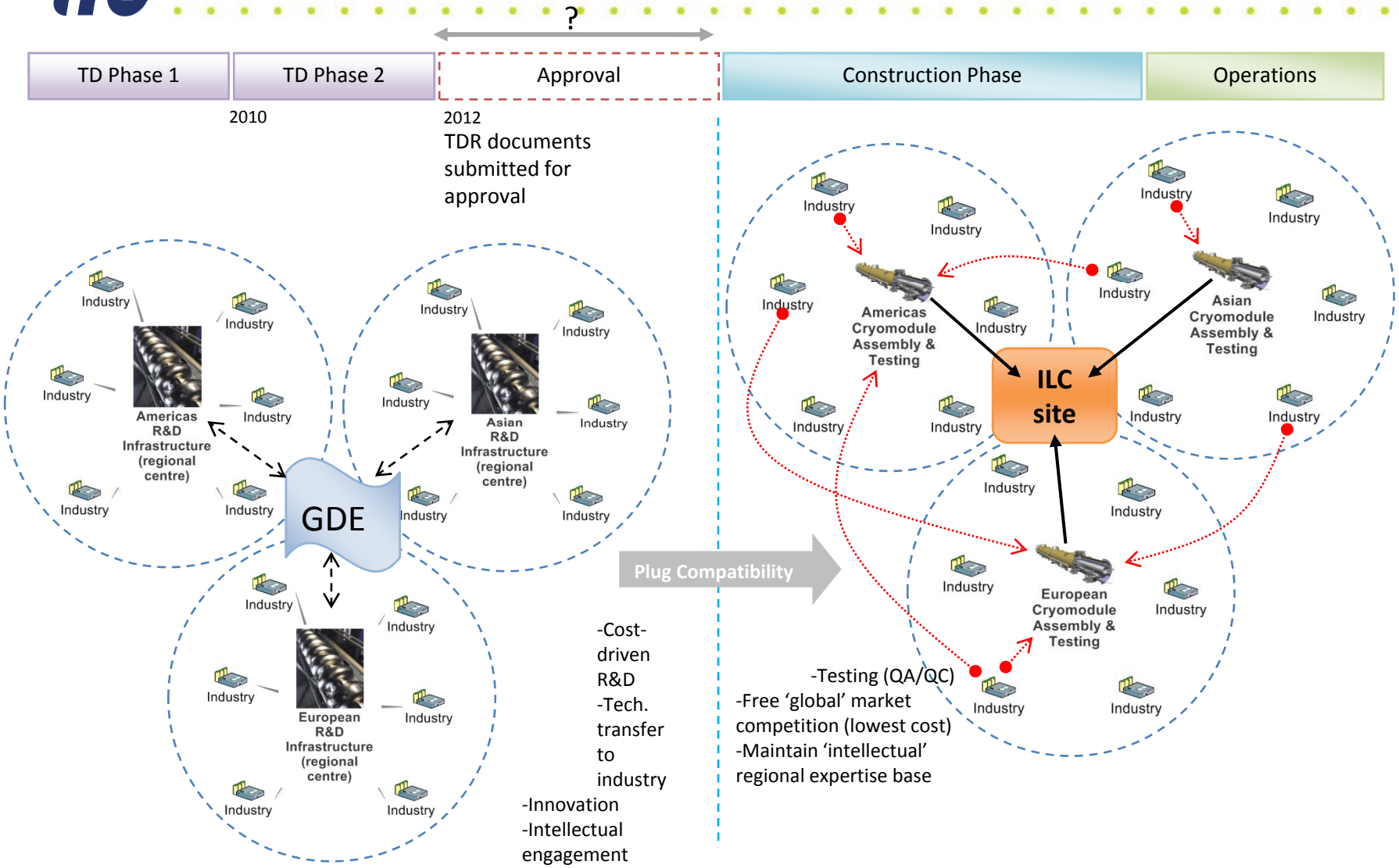
Project Implementation Plan

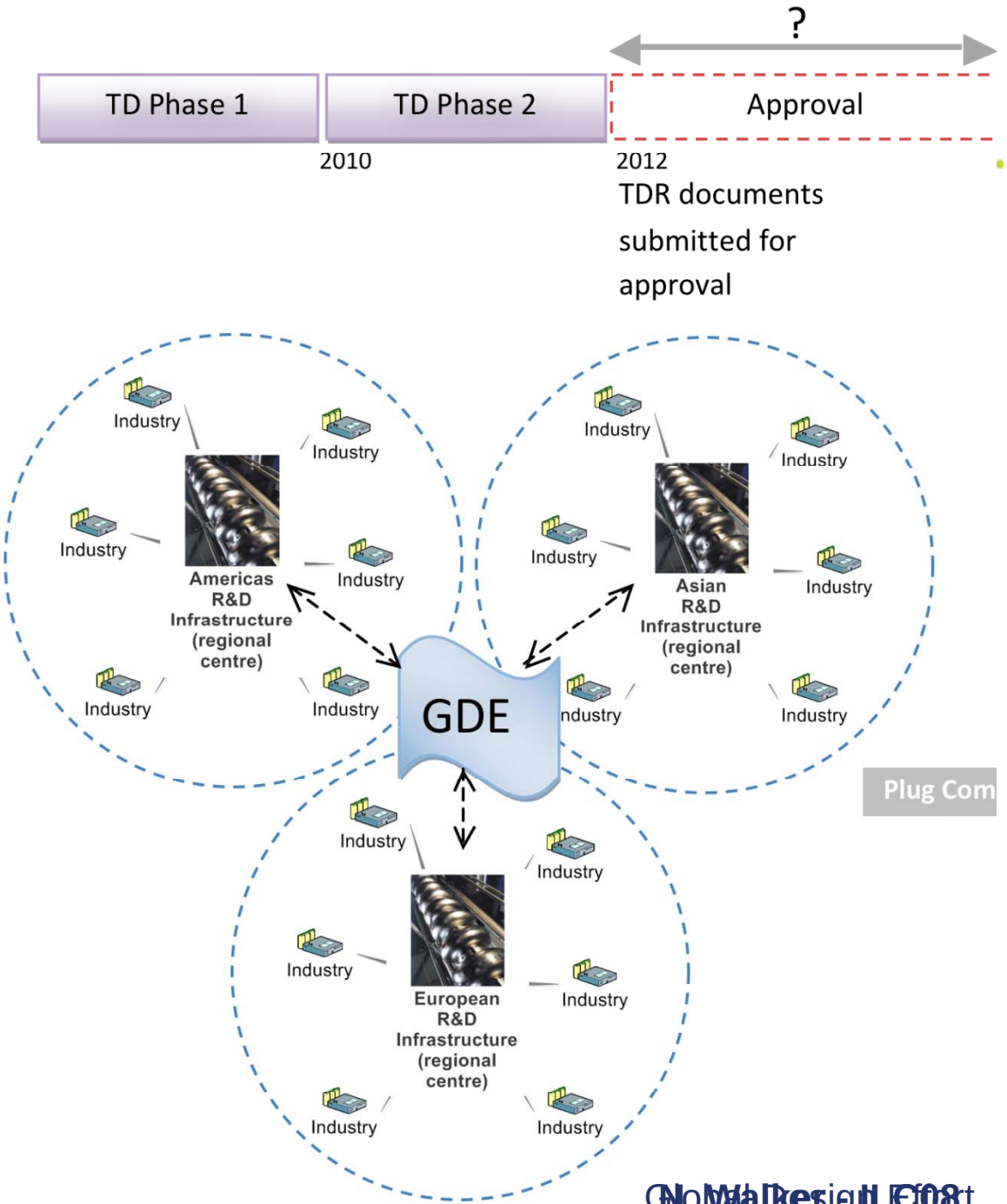


Preparing for a **rapid transition** to a **construction project**

Critical to engage **FALC** in this process

Transition to Construction Project



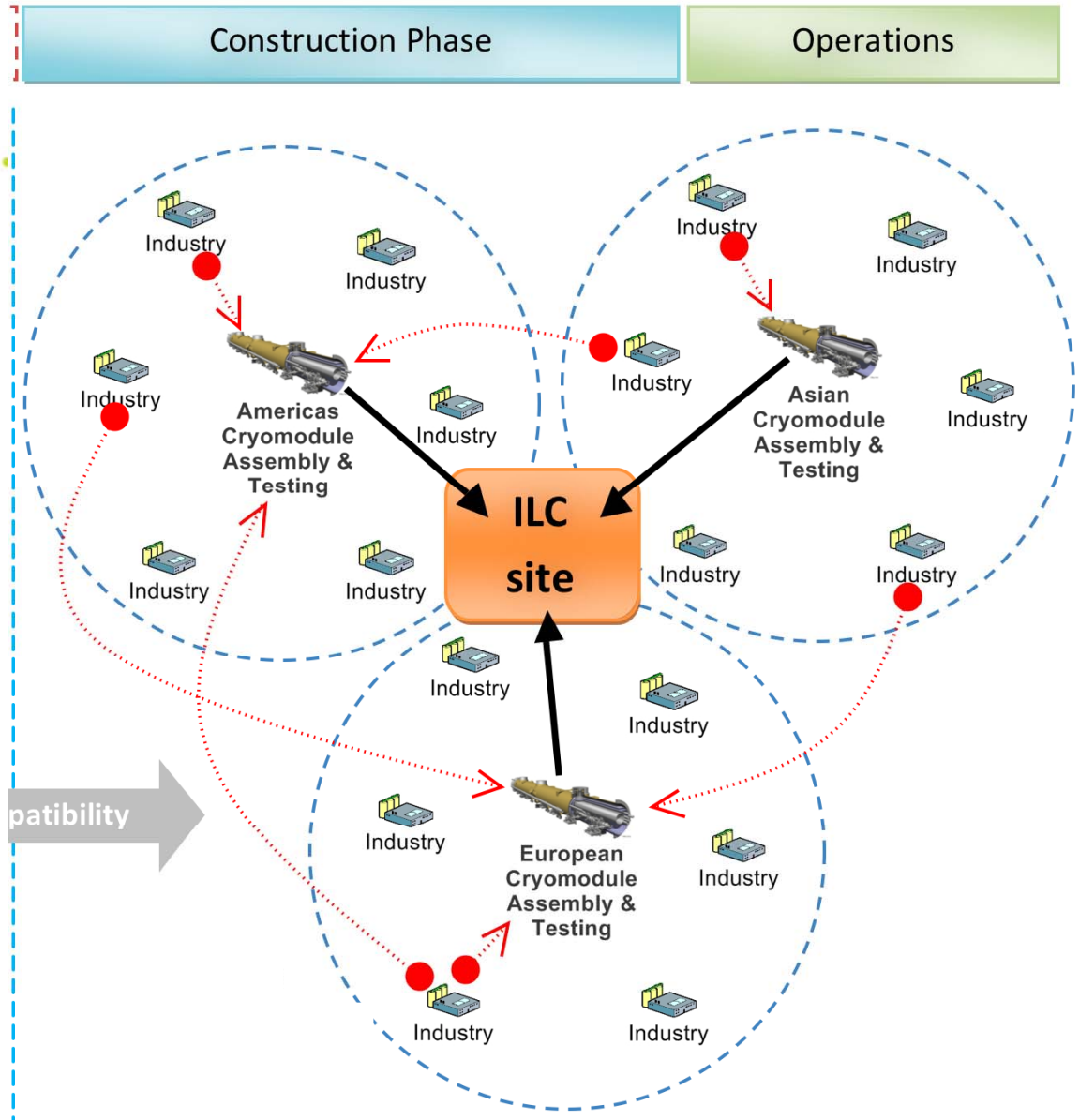


Global Cooperation: Plug-compatible Design and R&D

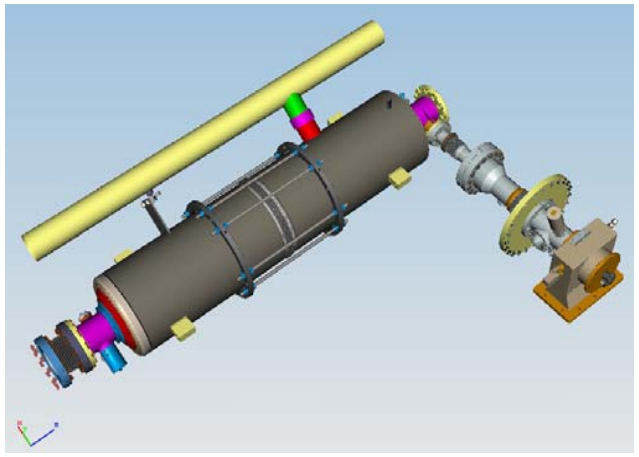
- Cost driven R & D process
- Technology transfer to Industry
- Innovation
- Intellectual engagement
- Expert base

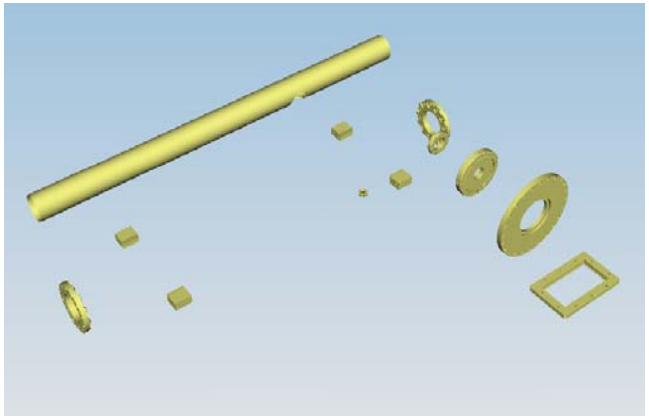
Global Production: Plug-Compatible Production

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



Plug-compatible Conditions





Item	Can be flexible	Plug-comp.
Cavity shape	TeSLA/LL/ RE	
Length		Fixed
Beam pipe flange		Fixed
Suspension pitch		Fixed
Tuner	Blade/Jack	
Coupler flange (warm end)		Fixed
Coupler pitch		fixed
He –in-line joint		TBD

Plug-compatible interface nearly established

2009 – 2010

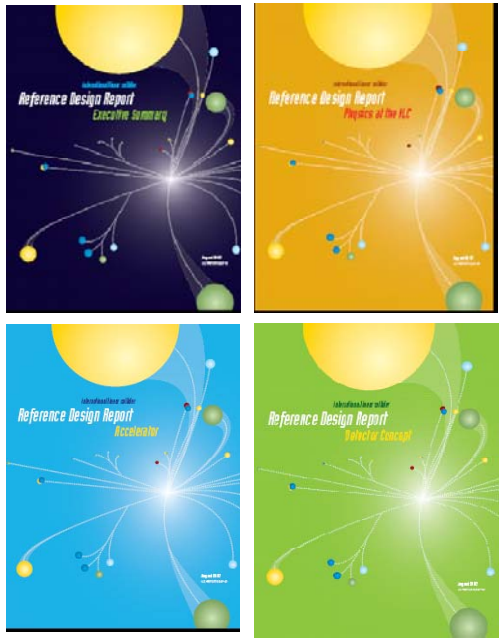
Proposed meetings and reviews:

- TDP1 Interim Review, Tsukuba – April 17-21, 2009 (Accelerator Advisory Panel, AAP)
- ALCPG Autumn 2009
- ILC Baseline update – January 2010
- TDP1 Final Review, April 2010 (AAP)
- ECFA Workshop, CERN – April 2010 (TBC)
- TDP1 presentation, ICHEP Paris - July 2010

CLIC-ILC Collaboration

- ILC08 is the first GDE meeting with substantial CLIC participation
  - **CLIC discussions included in *every* ILC08 accelerator system/ CFS parallel session agenda**
    - **also special sessions on project tools and cost / schedule planning**
  - **reflects similar integration of ILC within the CLIC08 Workshop held Oct 14-17, 2008**
- A foremost GDE goal is to tap the expertise and unique perspective of CERN engineers and scientists to develop the ILC design
  - **as done quite effectively during RDR**
- A second goal is to strengthen the link between the two teams
- Collaboration activities will be included in the AAP TDP1 Interim Review in April

TDP-2: Towards Project Approval



TDR
?

- RDR – Report in 4 Volumes
- Structure of TDR not yet defined (exact format and scope)
- Elements stated in R&D Plan
  - Updated technical design
  - Results of critical R&D
  - Updated VALUE estimate
  - PIP

Summary

- We have successfully survived “Black December”
  - **The importance of a being a Global project**
- Global Workshop attendance and output has been excellent
  - **Thanks again to all our conveners**
- Global investment in 1.3GHz SCRF technology paves the way for ILC construction
  - **The technology is “on the map”**
- Global Beam Test Facilities provide a focus for our community
  - **Exciting times with many facilities now coming on-line**
  - **Aggressively addressing RDR-identified risk**
  - **Providing a focus for education for a new wave of accelerator physicists**
- Much work remains for our Global Community to make this project a reality
  - **Beyond the technical to the political (PIP, FALC)**
  - **Importance of outreach and communication**

- We must stay focused on our mission to be ready

Final Comment

- Achieving our goals will require real leadership

  But can we do it?
  - With apologies to Obama …

YES WE CAN!