Project Management Report

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Nick Walker
Akira Yamamoto

TILC08 GDE Meeting – Tohoku University – Sendai, Japan
3rd March 2008

Contents

- US/UK funding problems
- EDR to TDR: a new strategy
- Primary focus: plans for SRF
- Other Priorities for the Technical Design Phase
- Cost Reduction
- Site Studies
- ILC-CLIC
- Workshop Working Groups
- Future Meetings & Workshops

“Black December”

“Both the UK and US actions are programmatic budget cuts and not rejections of the scientific goals and priorities that have motivated our work toward a linear collider.”

-BB

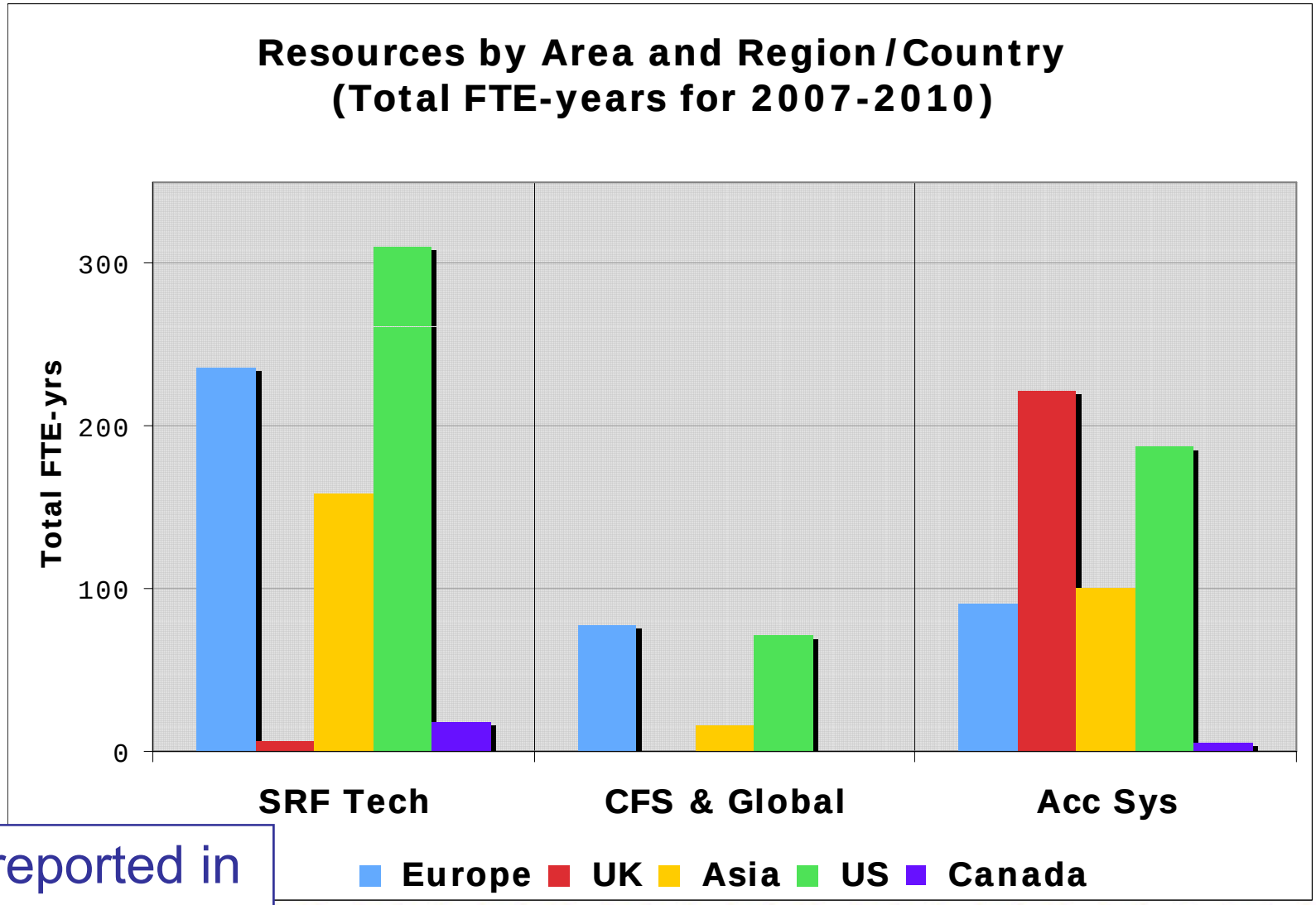
Resource Situation

- US
  - **2008 budget (15M$) almost completely spent in first ¼**
  - **FY 2009 President's budget – 35 M$ ☺**
    - Plus 25 M$ for FNAL SCRF infrastructure

- UK:
  - **Draconian statements on ILC support.**
  - **Any UK participation will now be only via "generic accelerator R&D".**
  - **Not expected to change in the next few years.**
  - **UK leadership hopefully to be maintained ☺**

- Rest of the World: Essentially Unchanged ☺

ILC-Specific Resources (R&D Plan)



As reported in R&D plan

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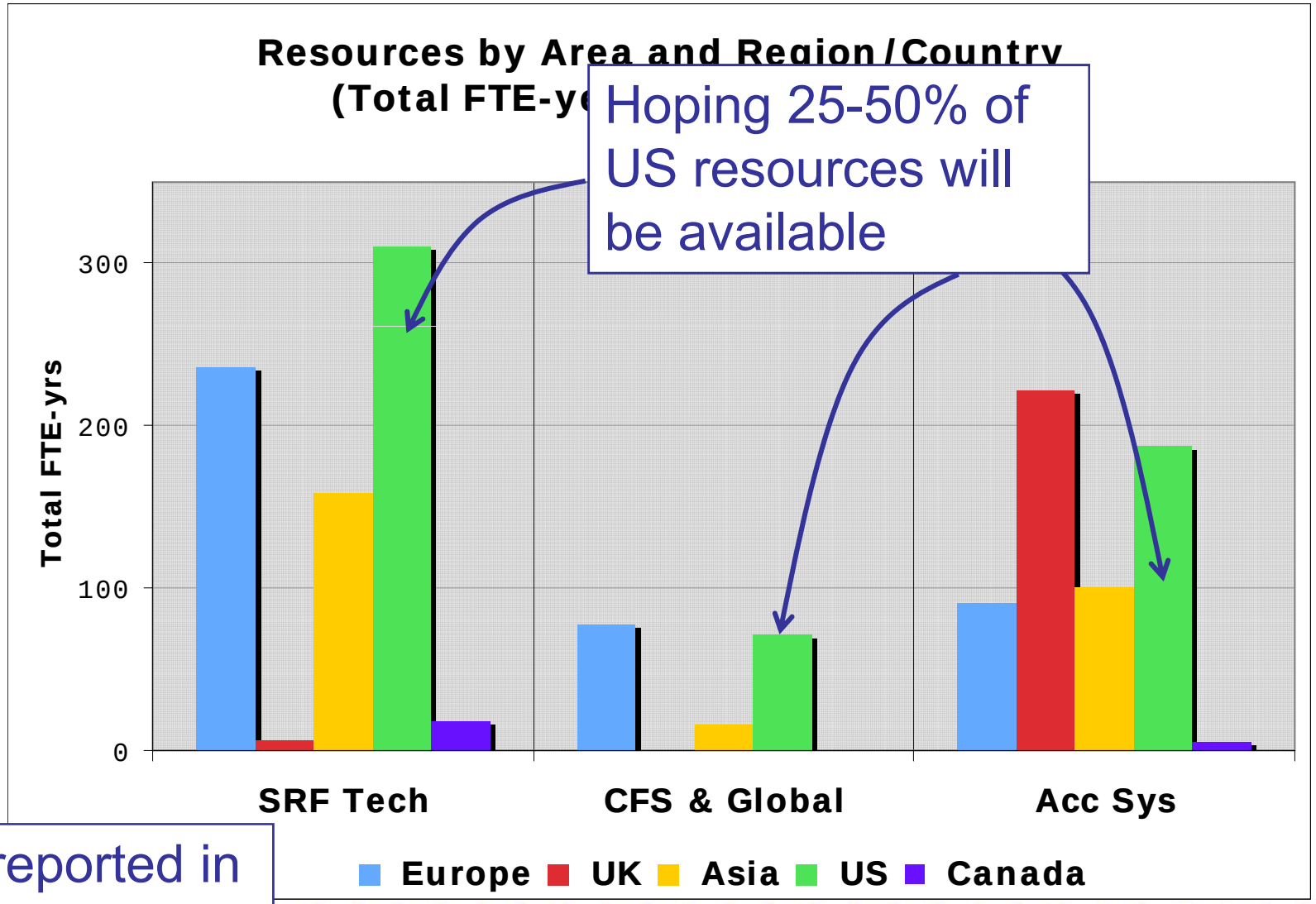
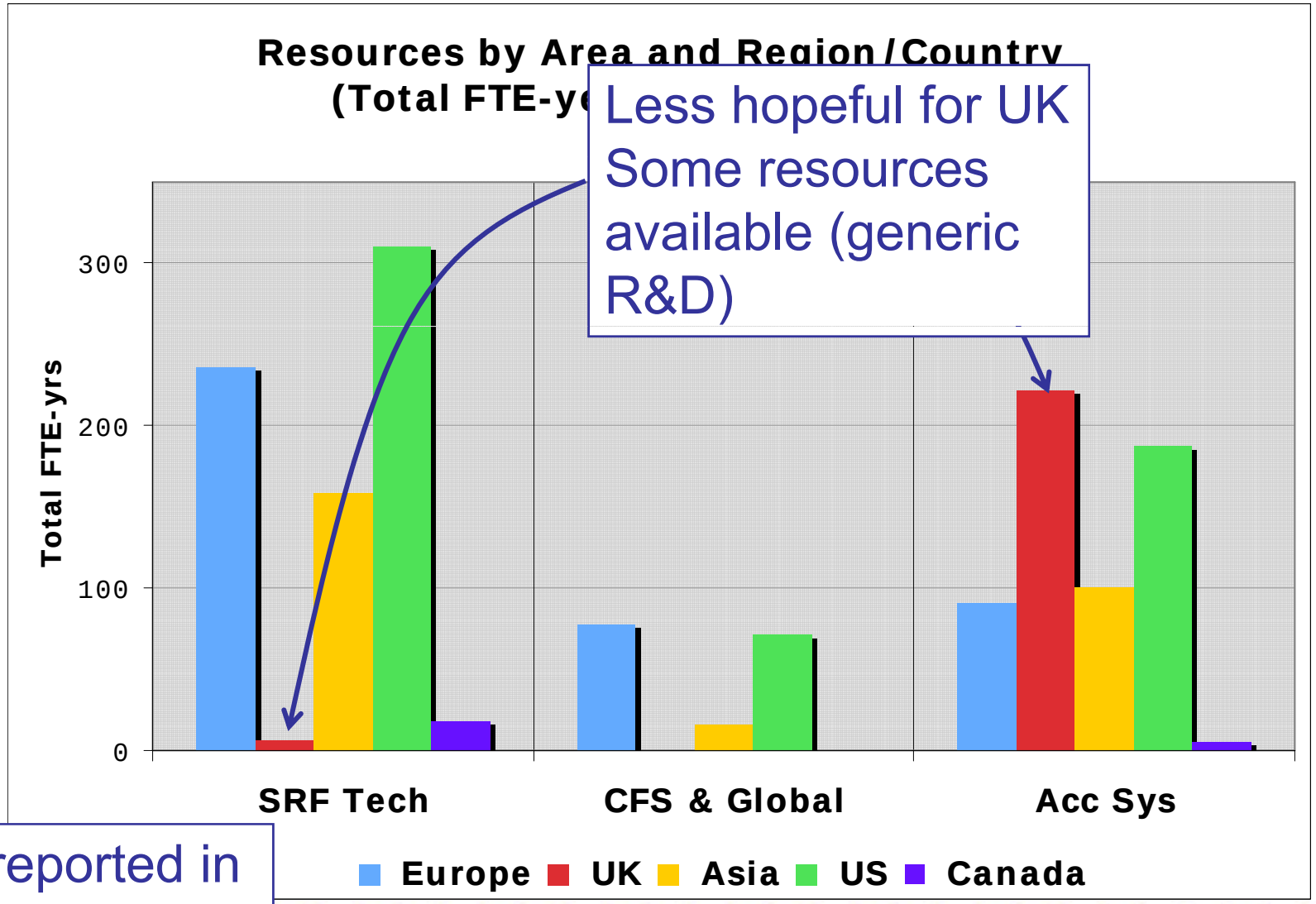


As reported in R&D plan

Global Design Effort

ILC-Specific Resources (R&D Plan)



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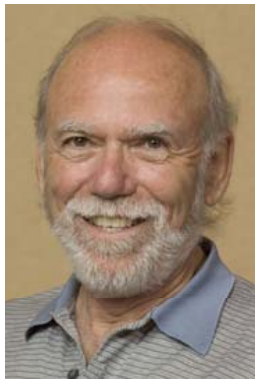
Global Design Effort

GDE Director Response:



- **THE SCIENCE !!!**
  - Nothing has changed. A linear collider remains the consensus choice as the highest priority long term investment for particle physics
- **Global Collaboration Response**
  - Strong response urging us to forge ahead and find ways to help or replace US and UK efforts.
  - Global commitment to the GDE Common Fund (*new*: Spain)
  - Offers of visiting appointments, equipment help, travel help, *etc*
- **Note the value of multilateral program! Can survive problems in parts of the consortium.**

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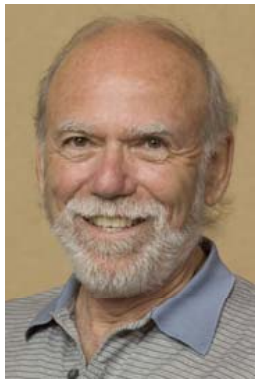

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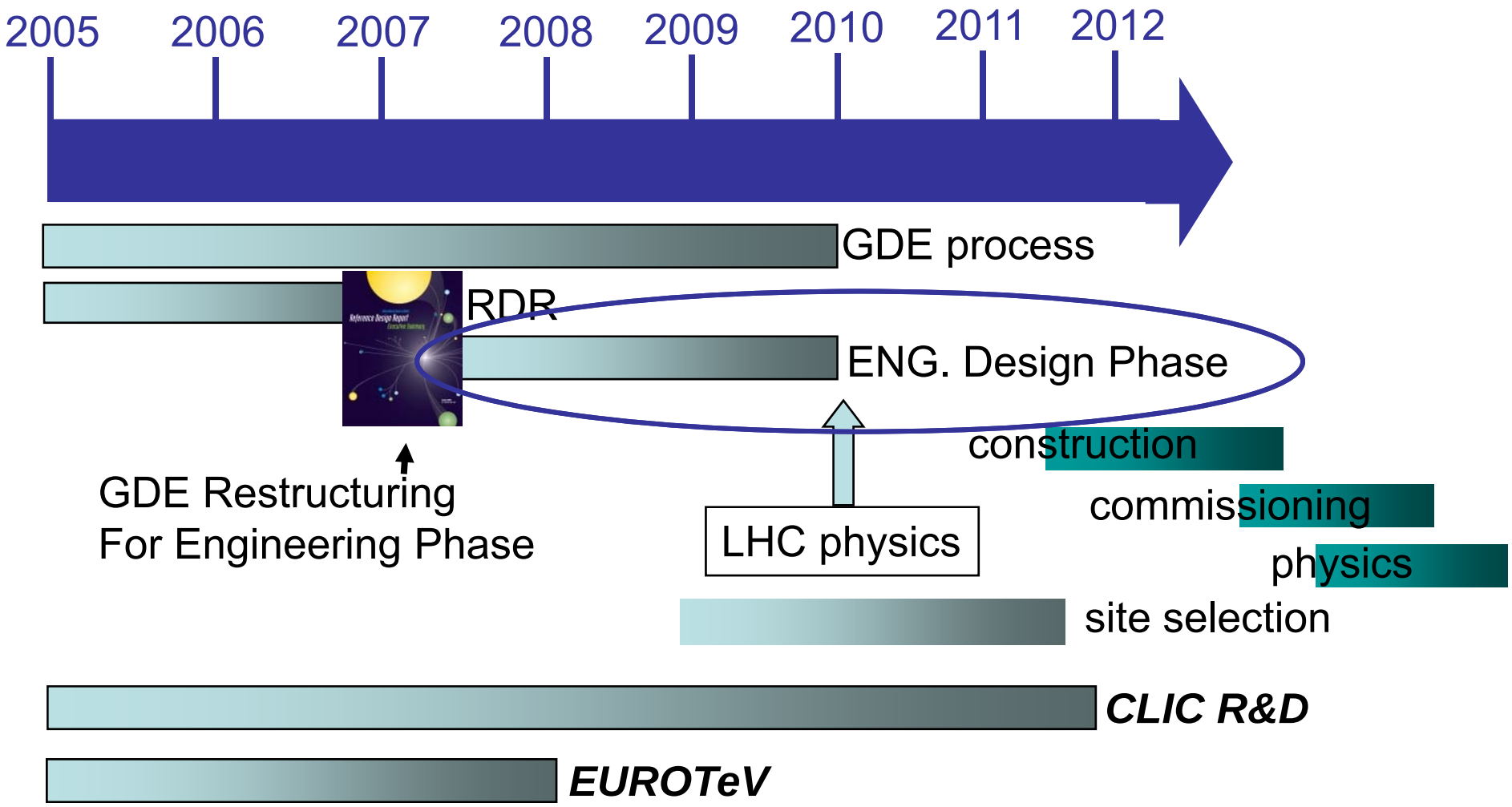
The ILC Engineering Design Phase

Global Design Effort

The ILC ~~Engineering~~ Technical Design Phase

ILC Projected Time Line (2007)



ED Phase Plan

ILC Research and Development Plan for the Engineering Design Phase

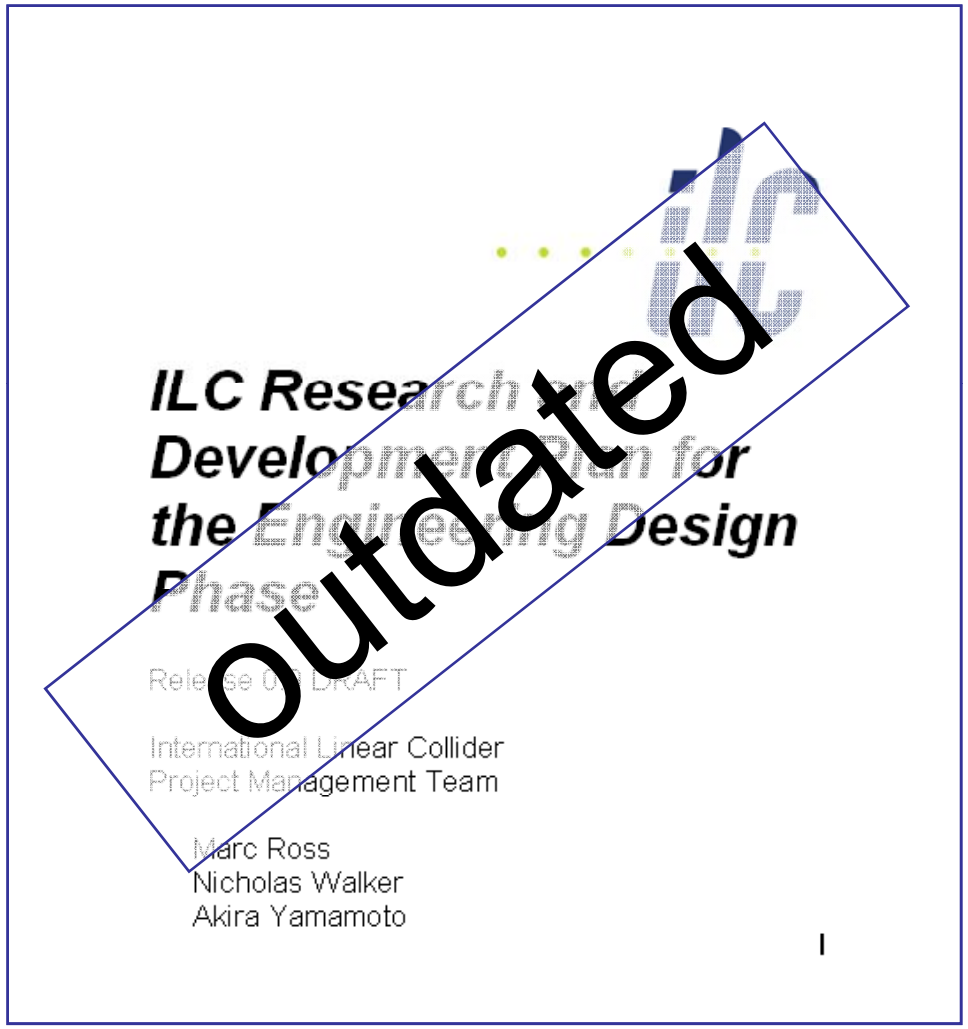
Release 0.9 DRAFT

International Linear Collider
Project Management Team

Marc Ross
Nicholas Walker
Akira Yamamoto

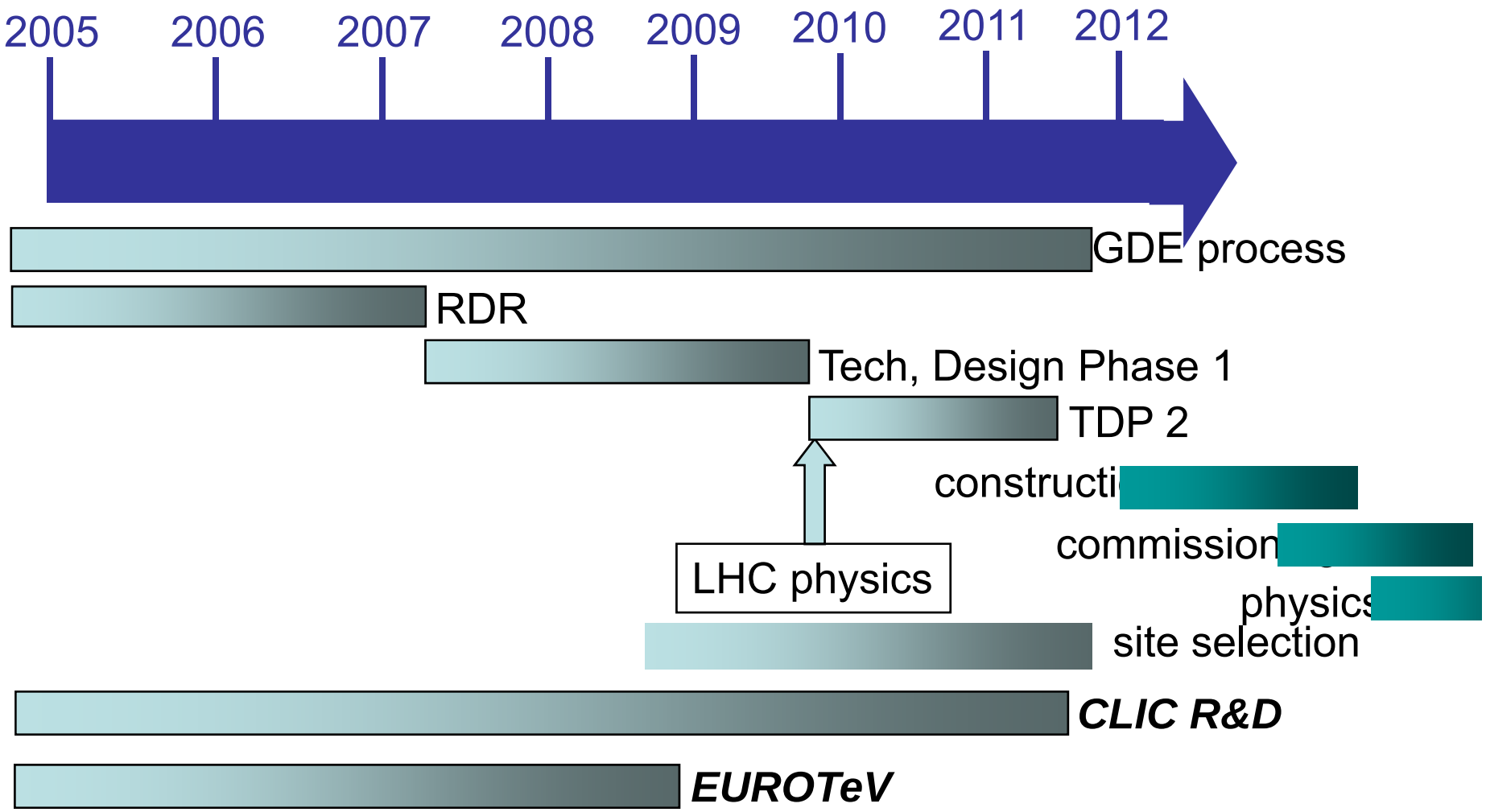
- R&D Plan outlines in some detail "*Global R&D Plan for the ED Phase*"
  - **Rationale**
  - **Primary goals**
  - **Tech. Milestones**
  - **Key tech. deliverables**
  - **Global resource base**

ED Phase R&D Plan



- R&D Plan needs revision to reflect loss of resources
- Project Management has reassessed scope of ED phase and proposed amended plan to EC
- Basic approach:
  - **Keep some critical (priority) goals for 2010**
  - **Delay others until 2012**
- Updated report due shortly after this workshop

ILC New Projected Time Line



The (Original) Plan (in a nut shell)

SCRF

- High Gradient R&D (reproducible 35 MV/m) →S0
- Cryomodule designs (plug compatibility)
- SCRF tech/Infrastructure in all three regions
  - **FNAL/KEK ramping up**
  - **DESY/Europe has XFEL**

CFS

- Where we intend to reduce the $$$$$!!
- CFS-driven schedule for Accelerator Systems
- VALUE engineering – process to reduce the cost.

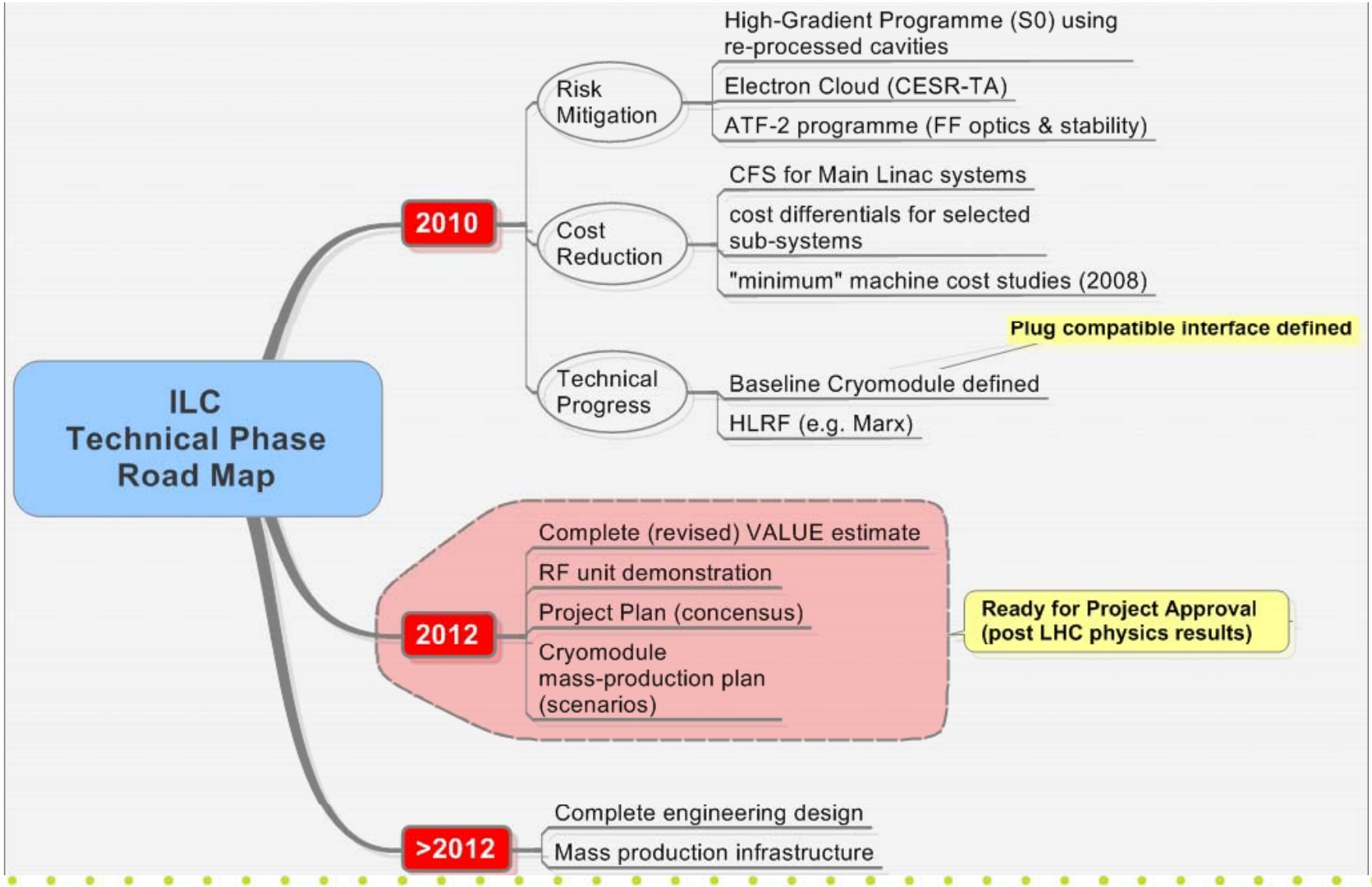
AS

- Cost/performance studies
- Supplying necessary information to CFS
- Test facilities (ATF, ATF-2, CESR-TA,…)

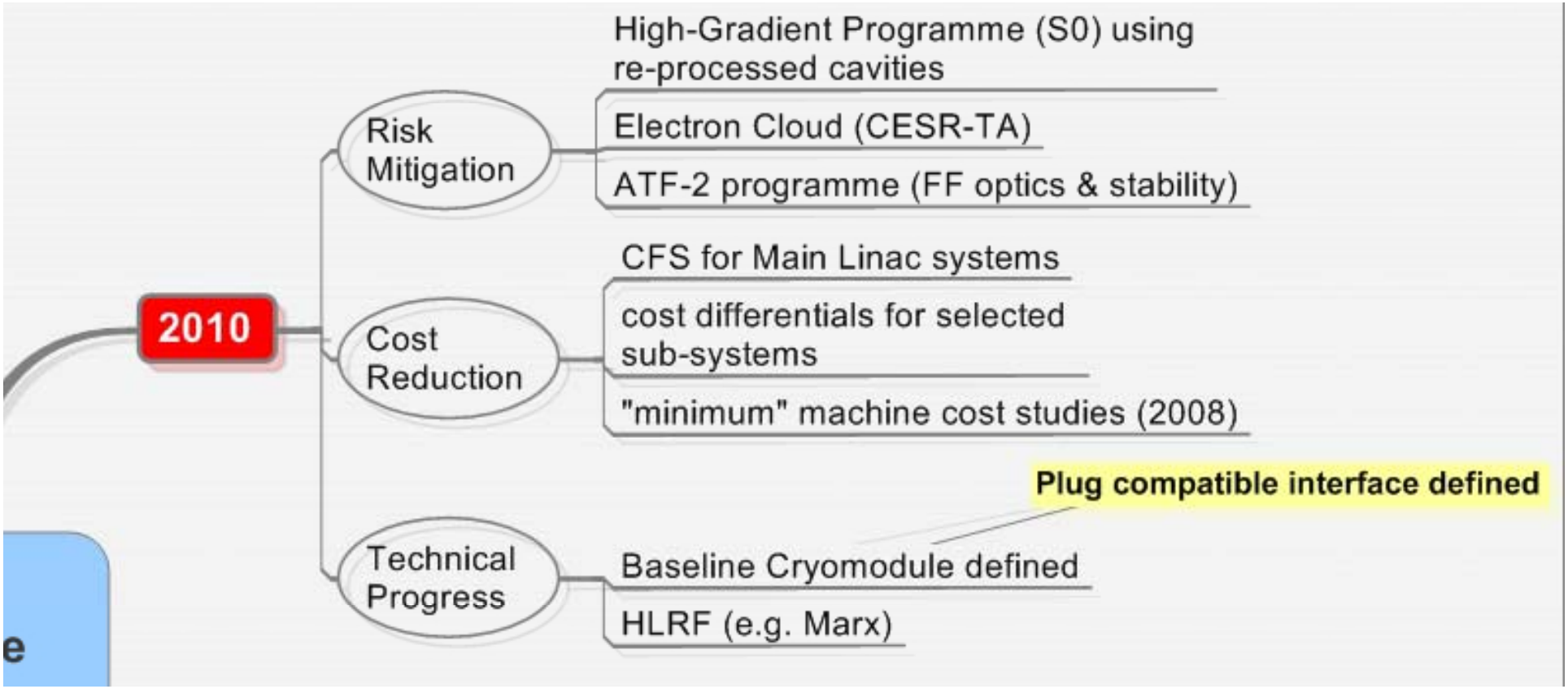
Re-Structuring / Re-Planning

- Basic road-map now exists
  - **Presented to and endorsed by FALC 18th January**
- Basic "ED-phase" priorities remain the same
  - **Gradient → S0**
  - **High-gradient cryomodule → S1**
  - **Cost reduction (CFS focus)**
  - **Test facilities (critical R&D → *electron cloud*)**
  - **"Plug Compatible" Cryomodule design**
- Response to funding reduction
  - **Keep priority R&D (risk mitigating) goals for 2010**
  - **Many final engineering activities delayed until 2012**
    - Including complete new VALUE estimate
    - Including Project Implementation Plan

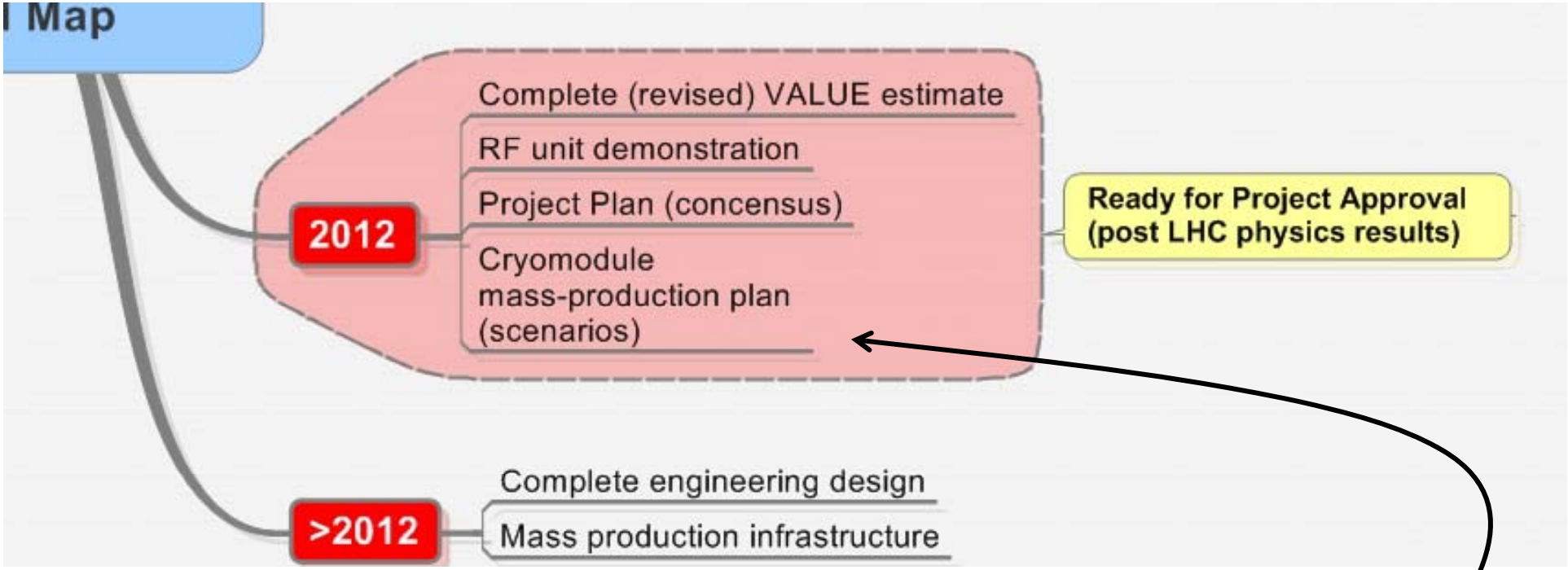
Technical Phase Roadmap



Technical Phase I Roadmap



Technical Phase II Roadmap



- Development of “plug compatible” linac components considered critical for global mass-production models
- XFEL (European) planned CM mass-production (in-kind contribution scheme).

Re-plan of ILC-SCRF R&D proposed

- **TDP1 by 2010:**
  - S0: **achieve 35 MV/m with 9-cell cavities at the yield 50 % under well defined processing-base,**
  - S1-Global: **achieve <31.5 MV/m> with cryomodule-assembly**
    - with global contribution (i.e., 4-AS, 2-US, 2-EU).
    - **Note: the S1 achievable also, if 3 Tesla-type cavities additionally assembled with existing 5 cavities in CM2 at Fermilab.**

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    - **Note: the S1 achievable also, if 3 Tesla-type cavities additionally assembled with existing 5 cavities in CM2 at Fermilab.**
- **TDP2-by 2012:**
  - **S0: achieve 35 MV/m with 9-cell cavities at the yield 90 % under well defined processing-base.**
  - **S1: achieve <31.5 MV/m> with full cavity-assembly (similarly processed) in single cryomodule, CM3 or CM4 (at Fermilab)**
  - **S2: achieved <31.5 MV/m> with 3 cryomodule assembly to be powered by 1 RF unit, and with beam acceleration, in STF-2 at KEK.**

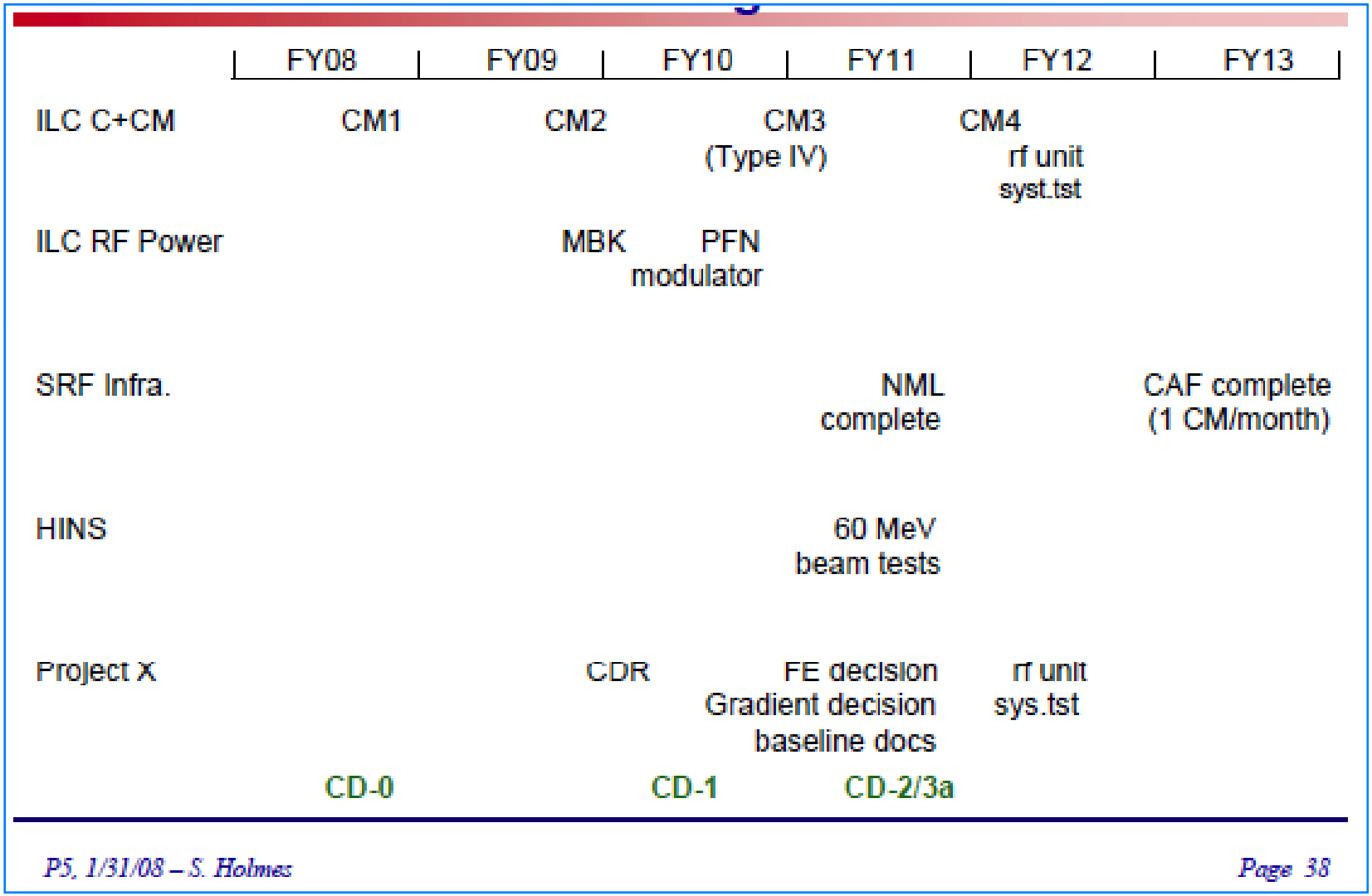
Global SCRF Plan proposed

		CY08		CY10		CY12
EDR	TDP1				TDP-II	
S0: Cavity Gradient (MV/m)	30					35 (>90%)
KEK-STF-0.5a: 1 Tesla-like						
KEK-STF-0.5b: 1 LL						
KEK-STF1: 4 cavities						
S1-Global (AS-US-EU) 1 CM (4+2+2 cavities)			CM (4_{AS}+2_{US}+2_{EU}) <31.5 MV/m>			
S2 & STF2: One RF unit & 3 CM with beam		design	Fabrication in industries		Assembled and test at STF	
S1-Fermilab/US ILC-CM-3 or -4		CM1	CM2	CM3(Type-IV)		CM4

Global Design Effort

SCRF R&D Plan at Fermilab

from P5 talk by S. Holmes



European XFEL

XFEL Module Schedule

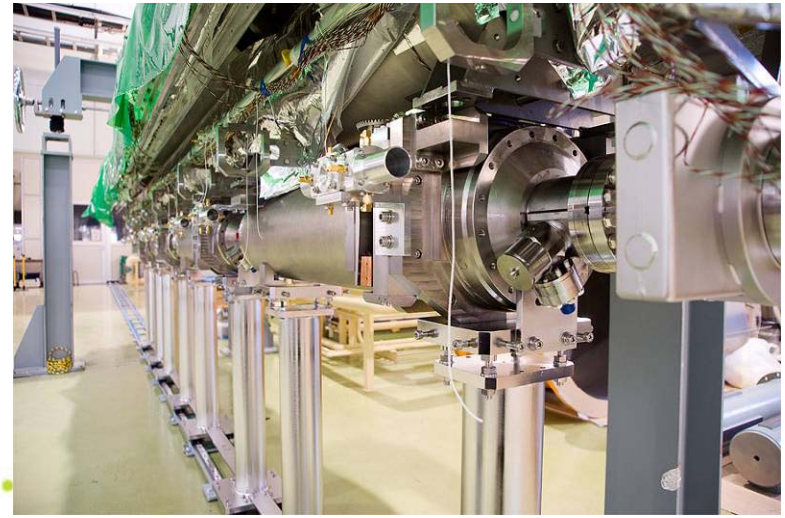
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Status:Nov-07 R. Lange																			
2	XFEL Accelerator Modul	y2007				y2008				y2009				y2010				y201		
3	M9 Type 3+ FNAL assembly																			
4																				
5	M8 Type 3+ DESY assembly																			
6	M8 Type 3+ Industry Study II																			
7	M8 Type 3+ Test CMTB																			
8	M8 Type 3+ new cavity string																			
9	M8 Type 3+ Test CMTB																			
10																				
11	M3* Type 2 Crash Test CMTB																			
12	M3** Type 2 assembly																			
13	M3** Type 2 Test CMTB																			
14																				
15	M10 XFEL prototype fabrication																			
16	M10 XFEL proto assembly/test																			
17	M11 XFEL prototype fabrication																			
18	M11 XFEL proto assembly/test																			
19	M12 XFEL p IHEP fabrication																			
20	M12 XFEL p IHEP assembly																			
21	M13 XFEL p Thales fabrication																			
22	M13 XFEL p Thales assembly																			
23																				
24	XFEL modules R & D																			
25	XFEL modules tendering, order																			
26																				
27	3 XFEL preseries fabrication																			
28	3 XFEL preseries test CMTB																			
29																				
30	101 XFEL series fabriication																			
31	101 XFEL series tests AMTF																			
32																				
33	XFEL XTL installation																			
34	XFEL XTL techn. commissioning																			
35																				

- 101 cryomodules
- 808 cavities
- Mass-production:
  1 CM/week in 2011/12
  (Saclay/Orsay/INFN)
- Commissioning 2013

FP7 ILC-HIGRADE

Preparation of STF-1a in Progress

Installation of the Tesla-like Cavities, Feb. 27, 2007



Superconducting Cavities

Table 5.1: Projected number of superconducting RF cavities available in each region and the number of planned tests for the TD Phase (TDP1 is 2004 to mid-2010), and up to 2012.

Americas	**FY06 (actual)**	**FY07 (actual)**	**FY08**	**FY09**	**FY10**	**TOTAL TDP1**	**FY11**	**FY12**
Cavity orders	22	12	0	10	10	**52**	10	10
Total 'process and test' cycles		40	5	30	30	**98**	30	30
Asia	**FY06 (actual)**	**FY07 (actual)**	**FY08**	**FY09**	**FY10**		**FY11**	**FY12**
Cavity orders	8	7	15	25	15	**59**	39	39
Total 'process and test' cycles		21	45	75	45	**152**	117	117
Europe	**2004-06 (actual)**	**2007 (actual)**	**2008**	**2009**	**2010**		**2011**	**2012**
Cavity orders	60*			838		**898**		
Total 'process and test' cycles		14	15	30	100	**109**	354	354
Global totals								
Global totals - cavity fabrication	90	19	15	873	25	**1008**	49	49
Global totals - cavity tests	**0**	**75**	**65**	**135**	**175**	**359**	**501**	**501**

* Thirty European cavities were ordered in 2004.

- From 2006 to 2012 with milestone at end of TDP I

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Reduction of ~130 Tests

- From 2006 to 2012 with milestone at end of TDP I

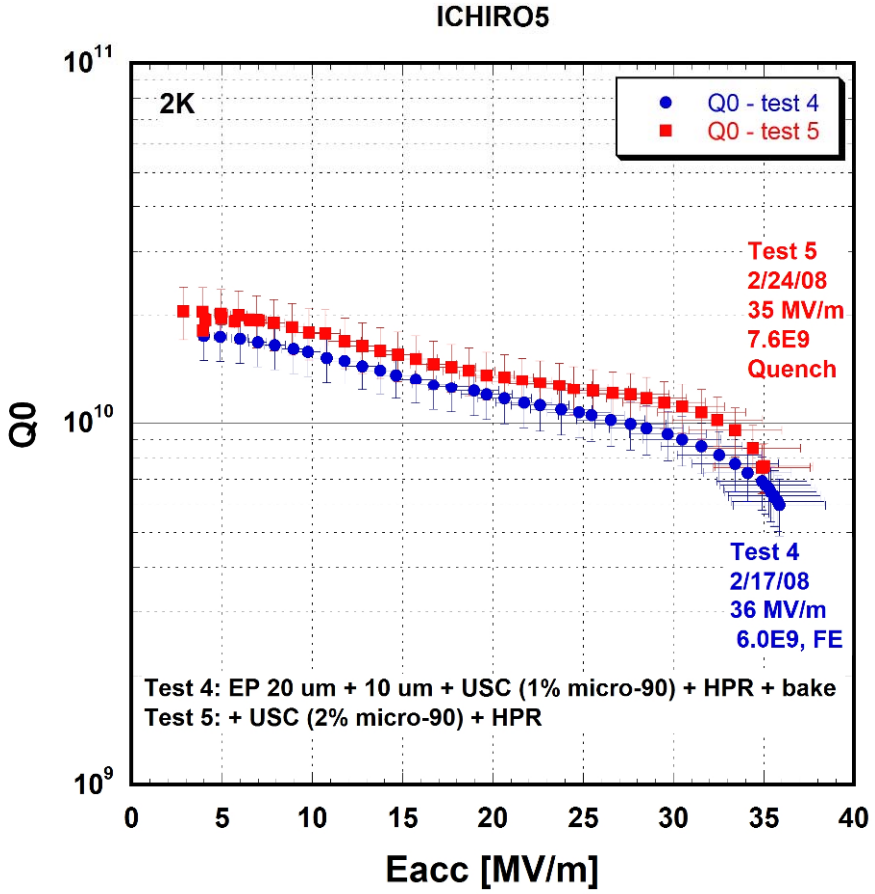
S0 Recent Highlights

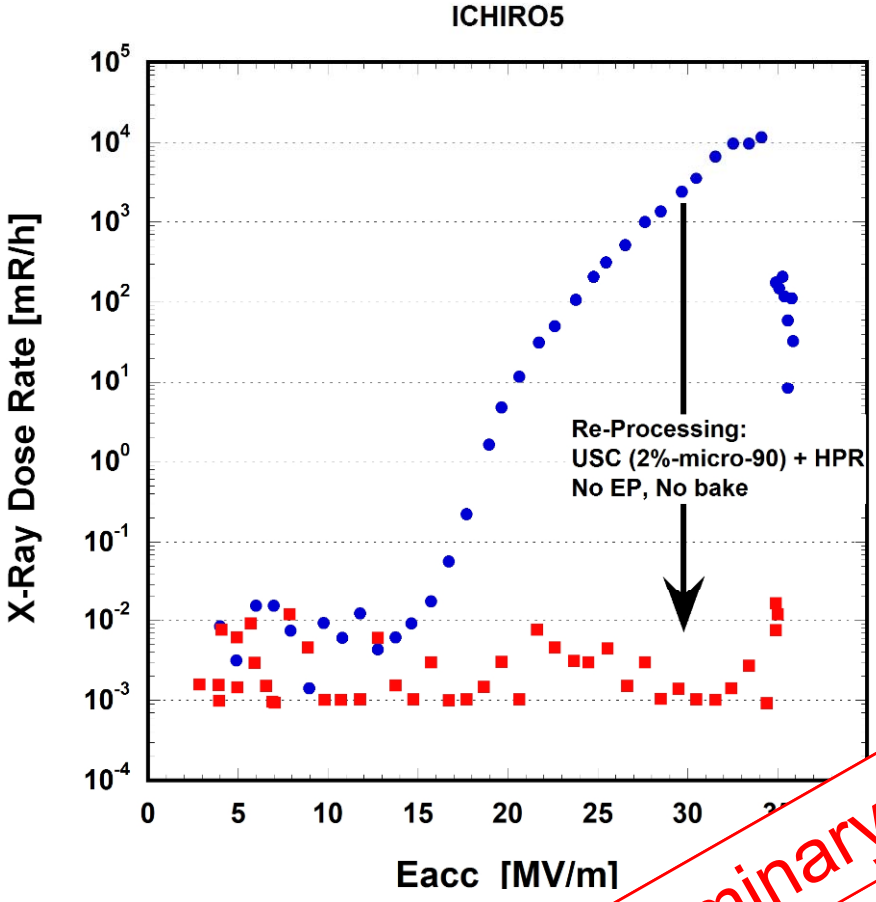
- January TTC meeting “Beyond Field Emission”
- Ethanol / detergent rinse results
  - **Significantly reduced FE**
  - **“classical” quench now limiting factor**
- Redirection of S0
  - **Understanding quench location**
  - **T-mapping essential**
  - **Optical inspection techniques**
    - Major breakthrough with Kyoto/KEK high-res camera
- Reduction in gradient spread remains primary issue
  - **But emphasis has shifted**
- The “end of field-emission” ?

→See presentation by H.Hayano

Progress in ICHIRO-#5 S0 Studies at Jlab

in cooperation with FNAL and KEK



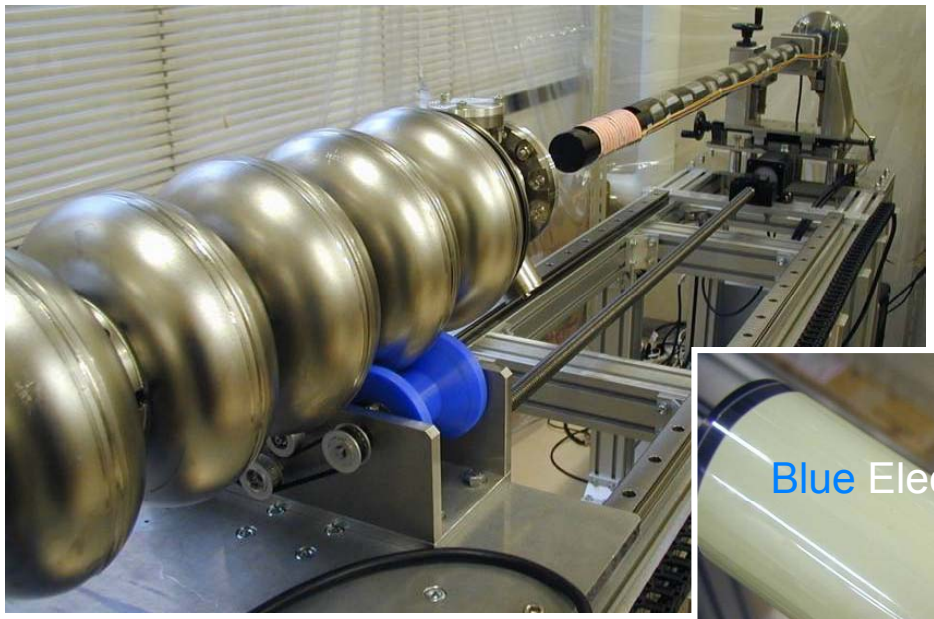


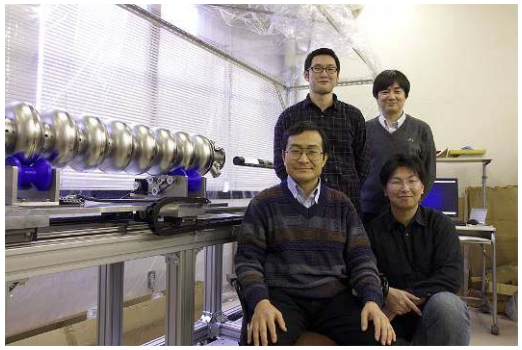
Preliminary!

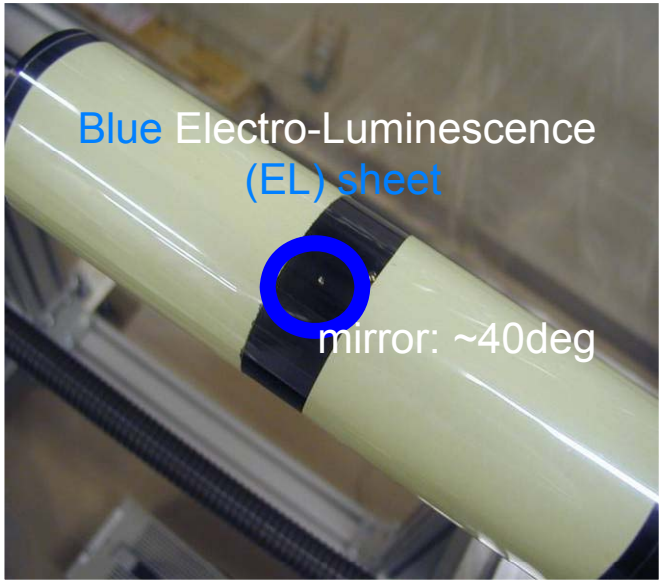
35 MV/m reached with 9-cell IHICHIRO cavities:
more report by H. Hayano

A Technology Recently Developed

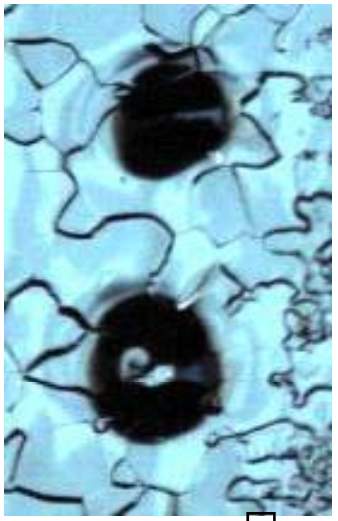
Kyoto/KEK Surface Inspection System:

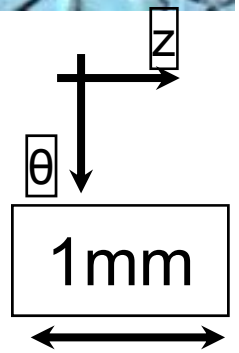






AES001 #3 cell 169°
Edge of heat-affected zone

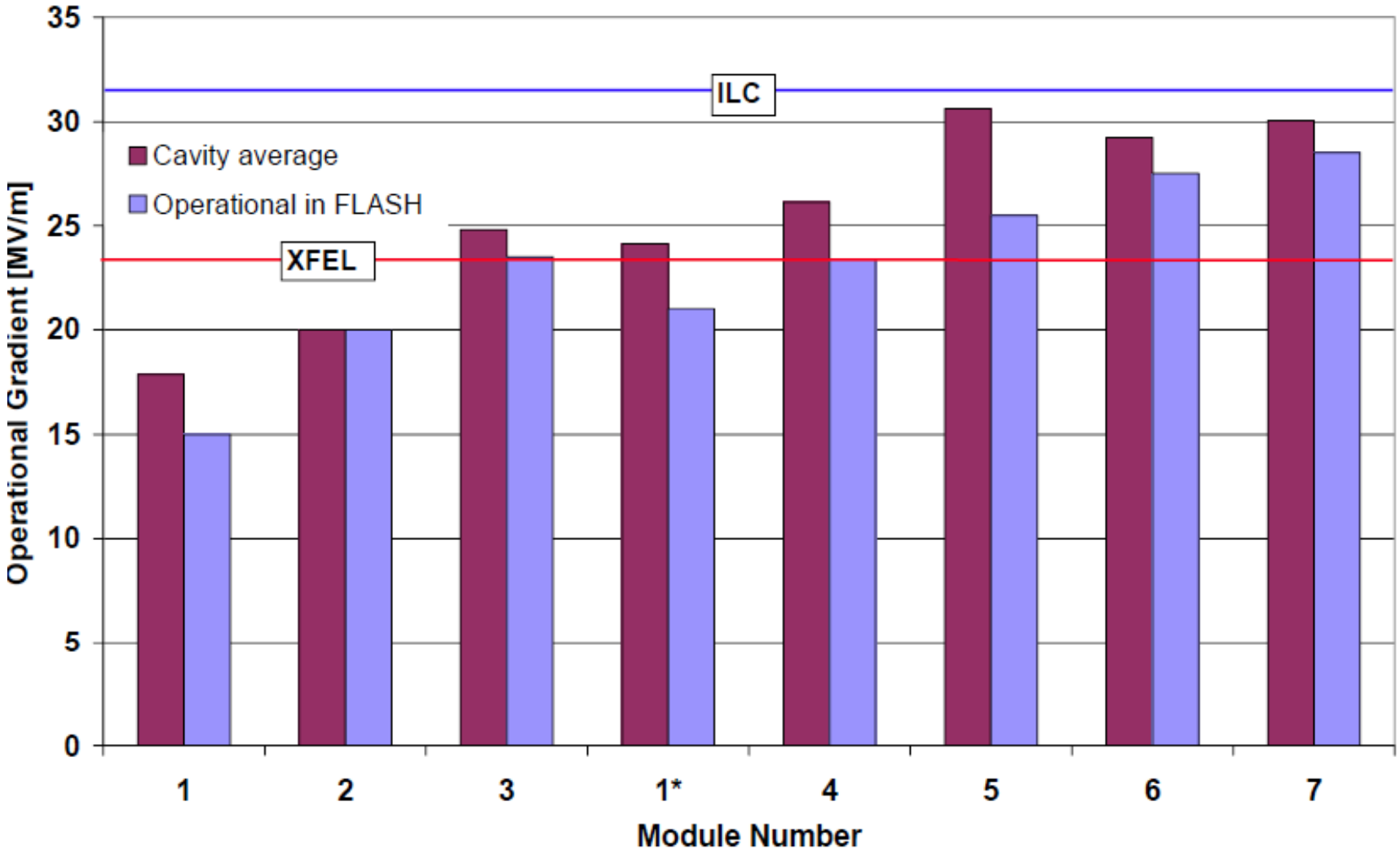




An End to Field Emission?

I'll Be Back!

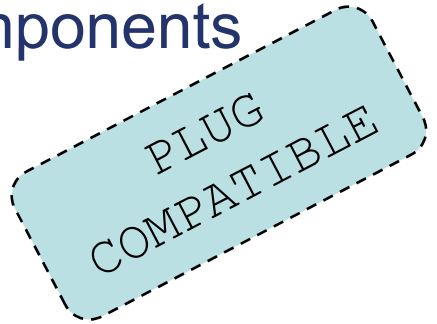
DESY Cryomodule Performance



Cryomodule R&D Strategy

Twofold:

1. Devise a cost model and construction plan based on a globally-unified design
   - Develop and test the model
     - Industrialization realized and demonstrated by XFEL
2. Aggressively promote cost savings / performance improvements
   - Specify interface between 6 basic components
   - Provide test facilities

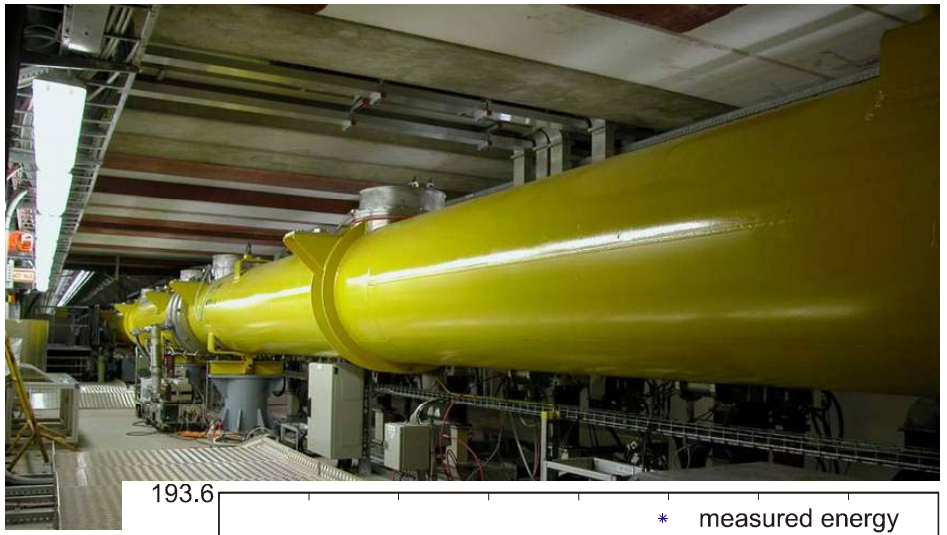


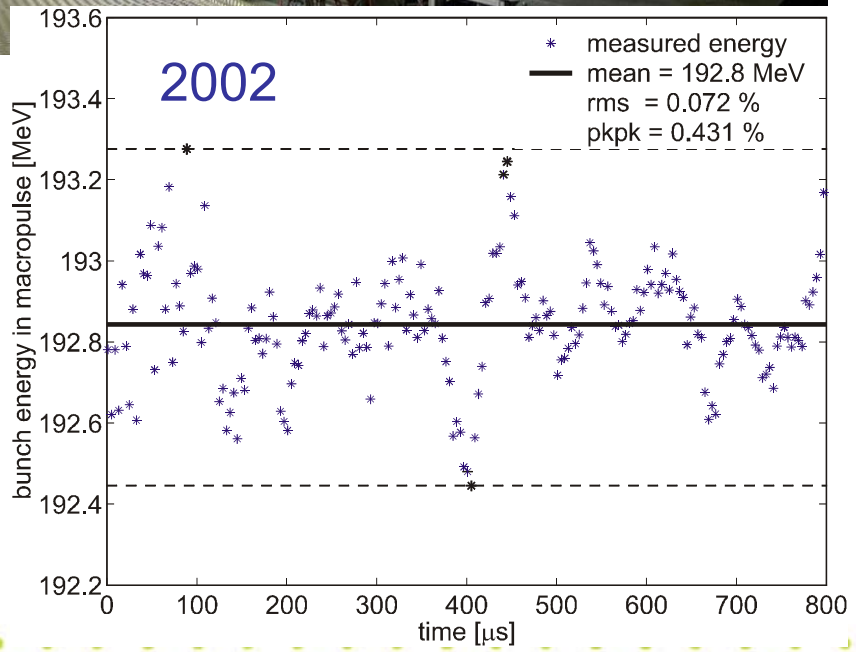
Mix and Match Cryomodule Design

- **CM with 6 modular sub-assemblies** — Cost fraction
  - **Cavity unit (cavity + helium vessel + tuner)** — **64%**
  - **Coupler** — **12%**
  - **Quad package (quad + corrector)** — **4%**
  - **BPM** — **2%**
  - **Cold-mass (cold-piping)** — **x/19%**
  - **Vacuum vessel** — **y/19%**
- **Plug-compatible, Interface specifications (IS)**
  - **To be fixed at Fermilab meeting, in April, 2008**
- **Plug-compatible IS** enables parallel development toward a single goal

9 mA Beam Tests at TTF2/FLASH

- 2 weeks in March 2009
- Full beam-loading
  - **2400 bunches**
  - **3.2nC bunches**
  - **800 us pulse**
  - **~1 GeV beam energy**
- Close to “high-gradient” limits
  - **Extended test period**
- Effectively a LLRF test





Other TD Phase Priorities

- RF Power Source R&D
- Electron-Cloud Mitigation R&D
- ATF-2
- Cost Reduction

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- **RF Power Source R&D**
- Electron-Cloud Mitigation R&D
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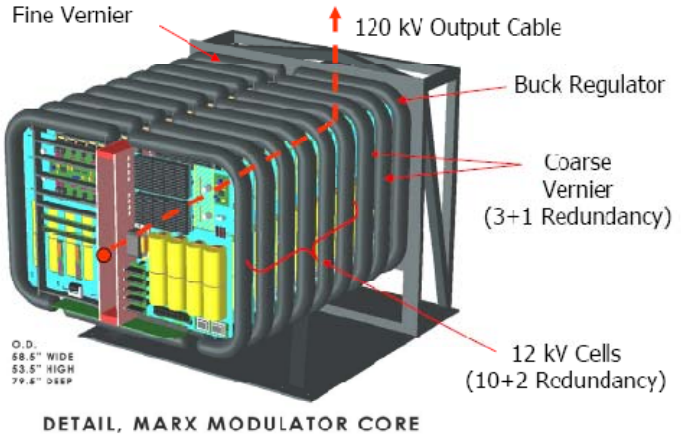
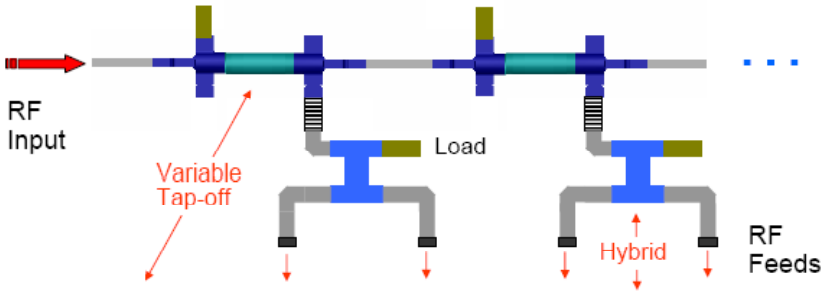
R&D into alternatives to current RDR baseline (SLAC)



DETAIL, MARX MODULATOR CORE



Other TD Phase Priorities

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- **Electron-Cloud Mitigation R&D**
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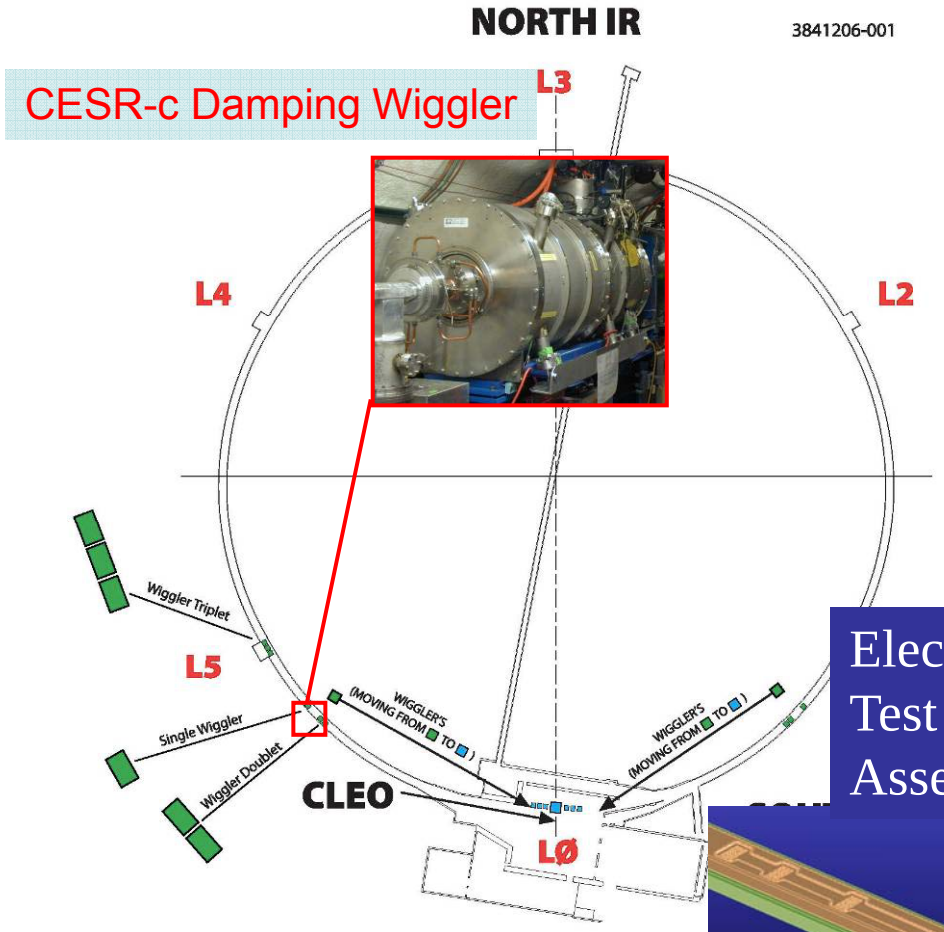
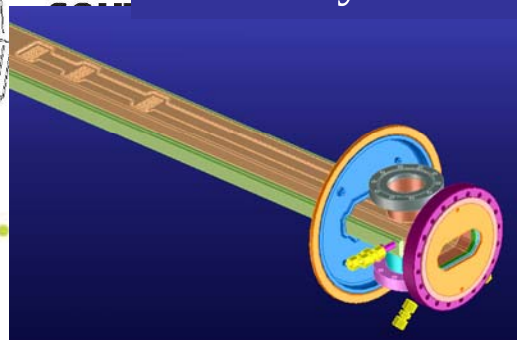
- Cost Reduction

CESR-TA Programme



Electron Cloud Test Chamber 1 Assembly



Other TD Phase Priorities

- RF Power Source R&D
- **Electron-Cloud Mitigation R&D**
- ATF-2
- Cost Reduction

A world-wide effort!

"Test Facilities"

KEK-B

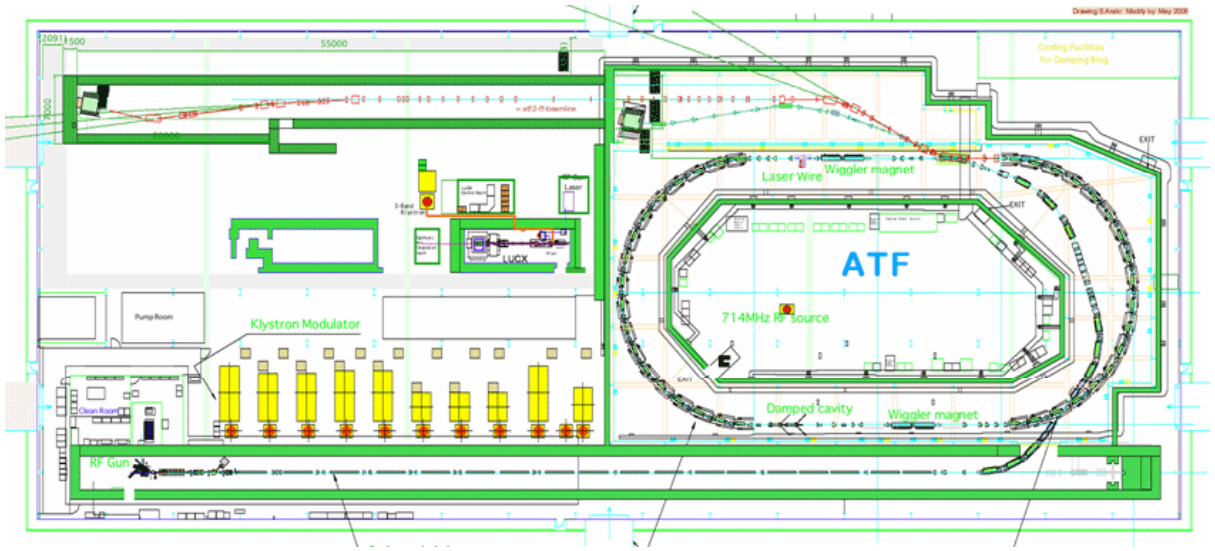
PEP-II

DELPHI

Large Theoretical Effort (many institutes)

Other TD Phase Priorities

- RF Power Source R&D
- Electron-Cloud Mitigation R&D
- **ATF-2**
- Cost Reduction



- FFS optics demonstration
- Stabilisation of “nanobeams”
- Instrumentation development
- International Collaboration

Other TD Phase Priorities

- RF Power Source R&D
- Electron-Cloud Mitigation R&D
- ATF-2
- **Cost Reduction**

- **CFS** still considered primary target for cost reduction
- Original plans for VALUE ENGINEERING across all sub-systems now delayed
- TDP-1 Focus of VE activity will be MAIN LINAC and IR Hall
  - **Potentially BDS**
- Production of CFS Criteria Tables is still a needed (look for resources)

more later….

Technical Milestones in CY 2008

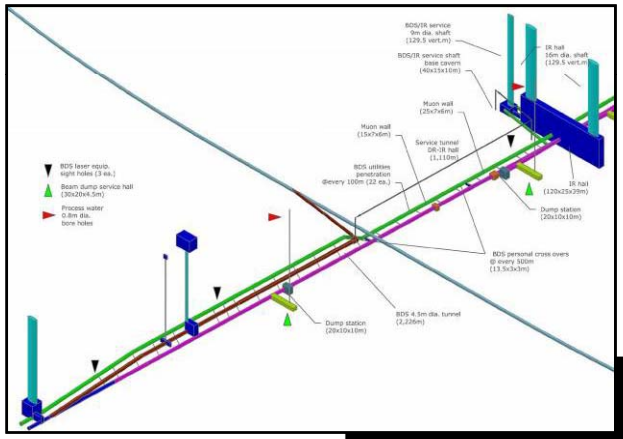
some examples

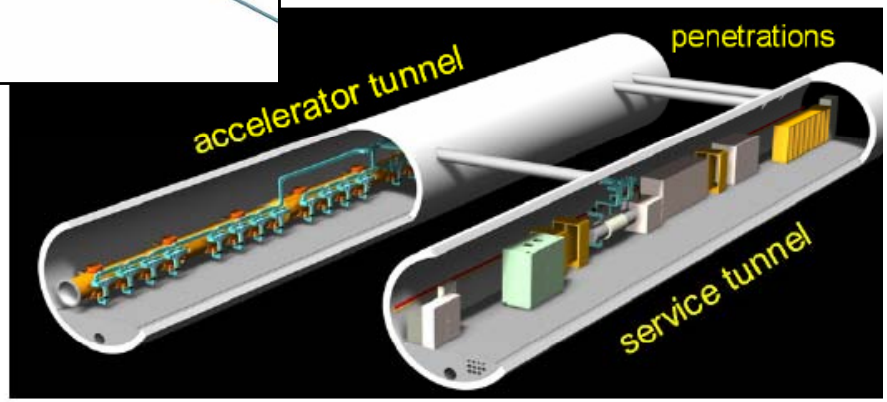
- Despite US/UK funding situation, important to show progress in 2008 where possible
- STF-1 NJW1
  - **4-cavity cryomodule (with TESLA shaped cavities)**
  - **(additional 4-cavity CM with Ichiro under discussion)**
- ATF-2
  - **first beam**
- CESR-TA
  - **Tests of EC growth in vacuum chambers at 2-2.5 GeV. Characterize growth as a function of bunch spacing, intensity, train configuration, emittance.**
  - **Continue beam-based alignment program to achieve ultra low emittance**
  - **Experiments at low emittance to explore instability thresholds and emittance dilution due to the ECI and FII**
- Others
  - **Damping ring baseline engineering lattice (← *this workshop*)**
  - **e+ source target and undulator prototypes**
- And, and, and….

Slide 43

NJW1 Can’t be an exhaustive list, but are there other things we can mention here?
Nicholas Walker, 2/29/2008

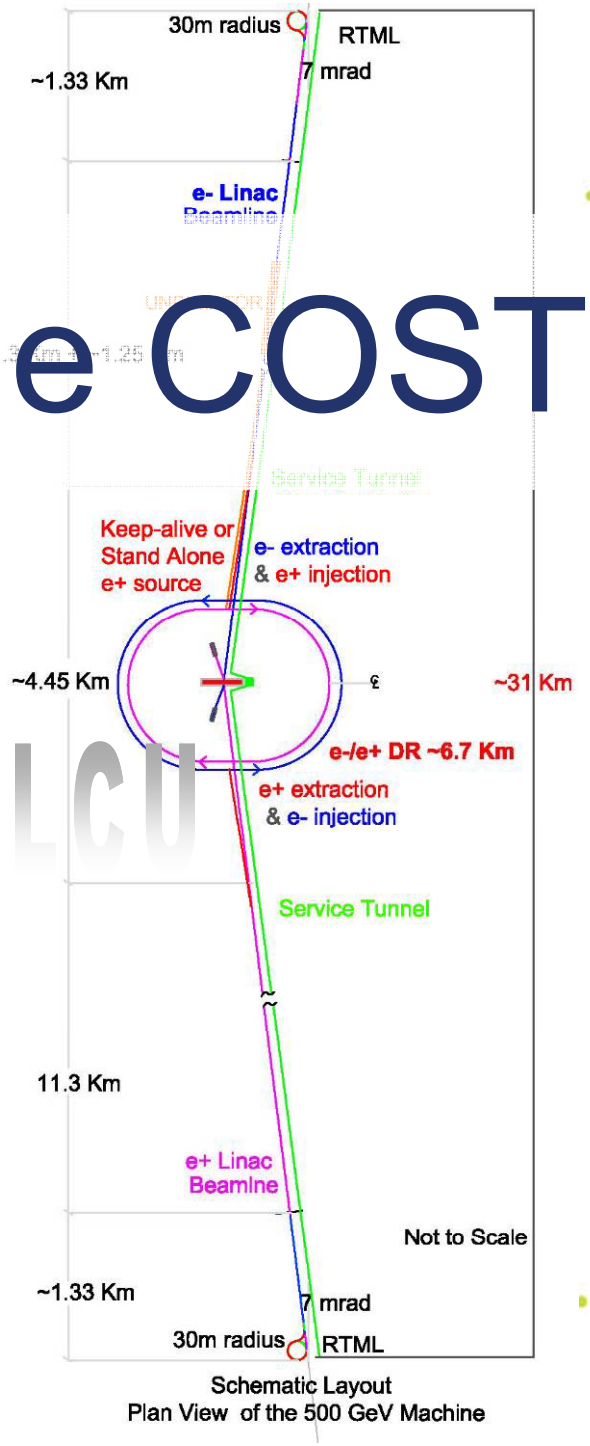
Reducing the COST





6.7 Billion ILCU

Global Design Effort



Schematic Layout
Plan View of the 500 GeV Machine

Cost Containment / Reduction

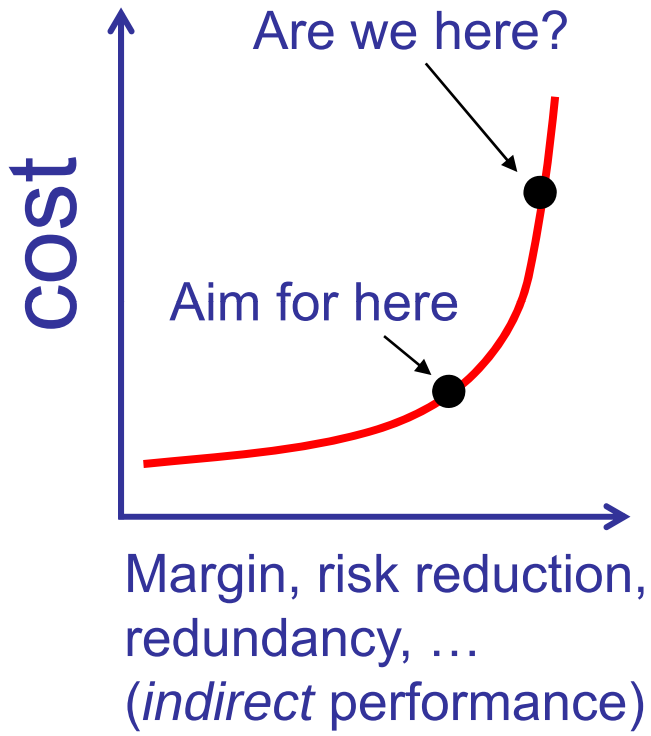
- Stated **Priority TD Phase Goal**

- Primary focus: CFS via
  - **Better-defined requirements**
    - From Accelerator Designers
    - From Technical System engineers
  - **VALUE ENGINEERING**

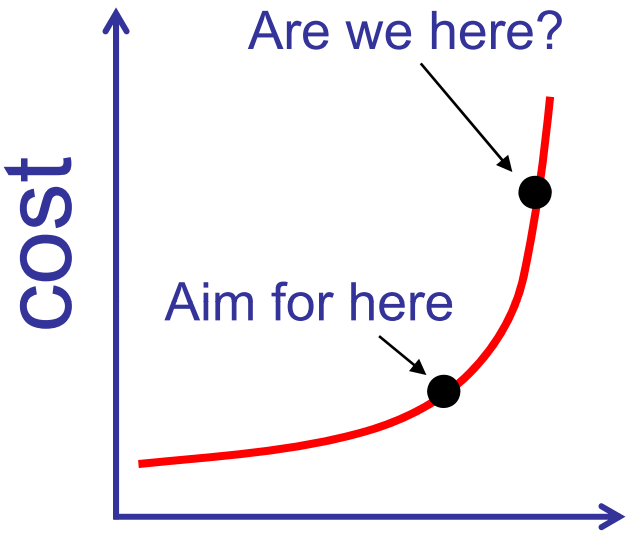
Iteration required

- Basic premise:
  - **RDR design is "sound"**
  - **CFS design is conservative**

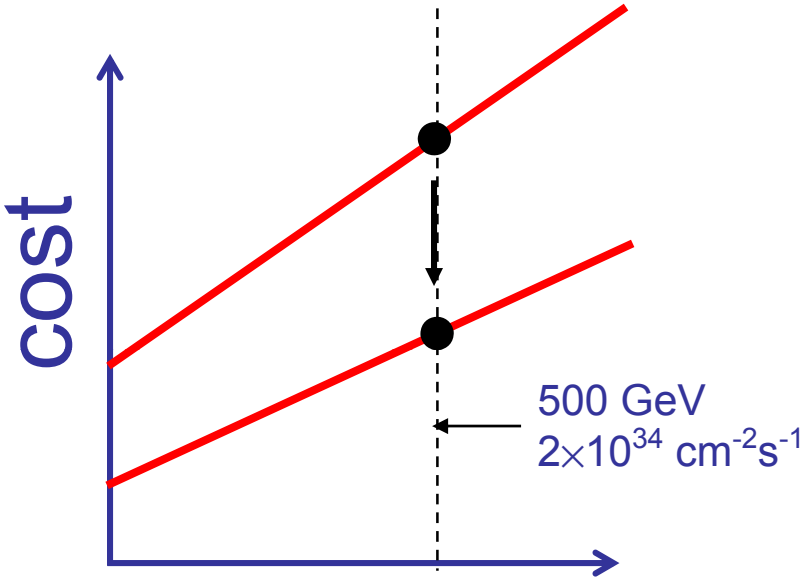
What we must do



What we must do

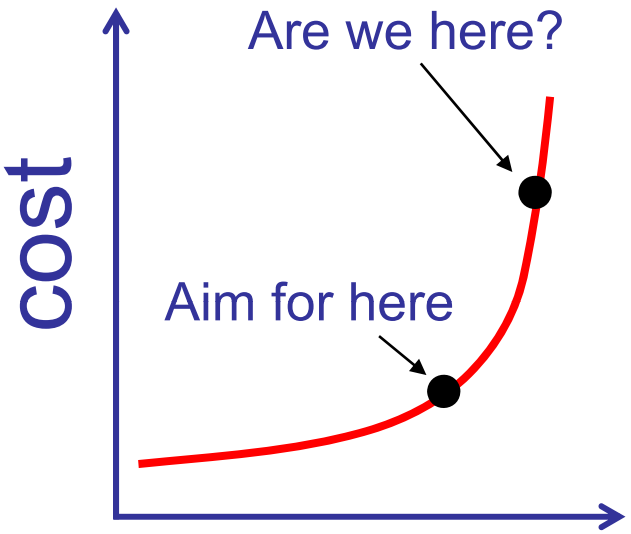


Margin, risk reduction, redundancy, …
(*indirect* performance)



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

What we must do



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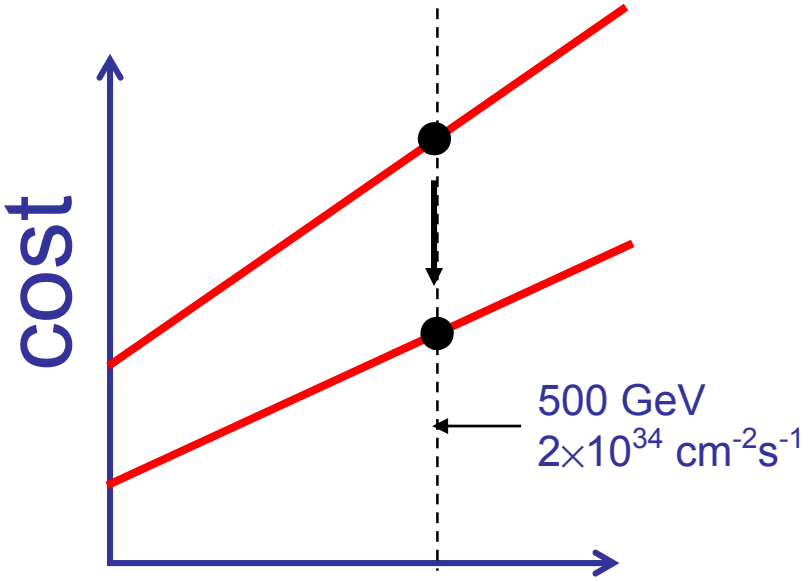

Physics "figure of Merit"
(*direct* performance)

Minimum cost machine
Understand the performance derivatives

Cost Reduction: A Strategy

- Required VE resources will be very limited in 2008
  - **Expect primary effort to begin end 2008**
- Use time to take a fresh look at RDR design
  - **Perform design/performance iterations that were not completed in RDR phase**
- Approach
  - **Continue "cost reduction" exercise begun after Vancouver '06 Workshop**
  - **Review proposals that where rejected (at that time)**
  - **Request new / innovative ideas for further reduction**
- Begin the process at this workshop (WG-1)
- Make plans for detailed studies over next months to one-year.
  - **Reports at LCWS (Nov 08)**

Primary Cost-Reduction Categories

1. Estimate Capitol Cost Saving
   - ***Is this a cost reduction at all?***
2. Direct physics parameter Impact
   - ***Initial capability***
   - ***Maximum Reach***
3. Staging → *SG-1*
   - ***Can impact be later mitigated with an "upgrade"?***
4. Risk impact
   - ***on reaching nominal performance***
5. Scope of proposed modification
   - ***Major layout change to plug-compatible component change***
6. Technical systems overhead
7. Impact on operations
8. Machine reliability
9. Scope of necessary R&D programme
10. Impact on TD phase planning
11. Impact on construction schedule
12. Site dependency issues
13. Initial study effort (primary required resources)

In the form of questions to be quantified (where applicable)

An Open and Transparent Process

- Post-Vancouver cost reduction exercise was very much a “select group” activity
  - **Mandated by RDR deadlines**
    - note: many RDR changes did not formally undergo change control
- Current studies will be (hopefully)
  - **Better focused**
  - **Better organised**
  - **Longer time-scale (several months → year)**
- Active group(s) will remain small and focused, but we must let broader community know what we are doing
  - **Canvas Feedback**
- Involve / inform HEP community for critical physics parameter impact studies
  - **Barry’s joint-plenary talk**

Cost Reduction is Not Easy!

- Goal: I want to reduce RDR value by 20%
  - **Approx: 1.3 BILCU**
- Easy way:
  - **Reduce length of main linacs by 40% and therefore the E_{cm} to 300 GeV**
- Hard way:
  - **Find 20×1% effects or 40×0.5% effects or 200×0.1% effects**
- The “Hard Way” is clearly more desirable
  - **Every %-level amount will count!**

Site Studies

- (Also a cost-reduction study)

- Shallow site
  - **Cut and cover + klystron gallery**
  - **Shallow tunnel + klystron gallery**

- Single-tunnel (XFEL-like) options
  - **An engineered / construction solution**
  - **We get this (almost) for free.**

- Focus of JINR (Dubna) GDE Meeting (06.08)
  - **JINR shallow-site studies**
  - **CERN (CLIC-ILC) collaboration**

Formally part of ILC-HIGRADE (European) programme

CLIC and the ILC (1)

- Necessary to bring two linear collider communities together
- A sharing of resources in a common framework.
  - **Many common features despite obvious differences**
- First discussions on initial identified themes at CERN (7-8.02)
  - **CFS**
  - **BDS & MDI**
  - **Cost & Schedule**
  - **Detectors**
- Slow start, but PMs (and CLIC management) generally pleased
  - **JINR GDE Meeting (June); CLIC Collab. Meeting (October)**
  - **resolved to aggressively pursue this new collaborative effort.**

CLIC and the ILC (2)

- ILC agenda:
  - **looking for CFS, planning & scheduling resources from CERN**
  - **Other: cryogenics, SPL, (not CLIC, not discussed)**
- CLIC agenda:
  - **GDE engagement in CLIC (the machine) design issues**
  - **Comparable cost basis for 500GeV CM machine**
- ILC-CLIC machine technical discussions positive
  - **Expectations on both sides high but**
  - **Reality is (available) resources on both sides are constrained**
  - **Slow start – still understanding the details**
  - **Key people are talking to each other!**

This Workshop

- WG-1 Cost Reduction Studies → presentation by W. Bialowons
- WG-2 SRF Main Linac Technology → presentation by H. Hayano
- WG-3 BDS/MDI
  - » IR integration
  - » ATF-2
  - » (CLIC)
- WG-4 Damping Rings
  - » Baseline “engineering” lattice
  - » CESR-TA & ATF programmes (e-cloud)

Focused on critical TDP 1 priorities

Future Meetings

- April 7-8 DESY Zeuthen
  - **Positron source meeting**
- April 21-25 FNAL
  - **SRF Main Linac Technology Review**
- June 4-6 JINR (Dubna)
  - **GDE Meeting: ILC CFS Workshop**
- July 7-11 Cornell
  - **Damping Ring Workshop (CESR-TA)**
- November 16-20 Chicago
  - **LCWS / GDE Workshop**

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Planning for these GDE Meetings starts at this meeting!

Last-but-one Slide

- "Black December" will remain a low-point in our endeavours
  - **We look (hope!) for better future times in US and UK**

- Despite problems, progress is being made
  - **Rapid re-structuring of GDE plans**
  - **Significant progress on all fronts (esp. SRF)**

- We must now be forward-looking
  - **Build on the long-standing enthusiasm of the collaboration which remains our anchor**
    - Impressed by contributions despite (or perhaps in spite) of funding crisis

Last Slide

- PMs primary challenge: resources!
  - **A global search.**
  - **On-going negotiations with institutional management**
  - **Continually looking for “mutual benefit”**

- Project Management is 100% committed to a successful outcome of the TD phase programme
  - **But we cannot achieve anything with your support**

Thank you for your attention