GDE (RDR) Update

Nick Walker

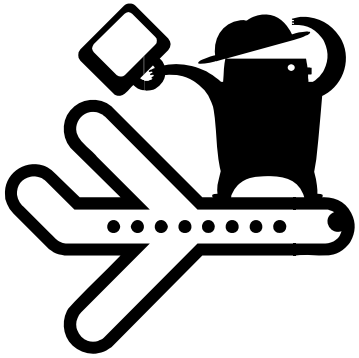
ILC-GDE

DESY

Contents

- The Last Year in Perspective
  - **Summary of what has happened since Frascati GDE meeting November 2005**
- From Vancouver to Valencia
  - **Cost reduction exercise and design changes**
- RDR schedule up to Beijing
  - **The last 100m**
- Global R&D
  - **The ‘S’ task forces**

The Last Year in Perspective



One year after Frascati

- **Frascati 12/05:**
  Snowmass Baseline Configuration (BC) consolidated and ratified
  - **BC officially placed under Change Control Board (CCB) control**
  - **Many technical "details" poorly specified (or missing)**

- **Bangalore 03/06**
  Detailed design reviewed and iterated; planning for cost estimation
  - **RDR Management Board formed**
    Barish, Bialowons, Garbincius, Raubenheimer, Shidara, Walker (chair), Yokoya
  - **Weekly videoconferences across Area and Technical System (AS/TS) set-up**
  - **Cost guidelines for TS developed (ETA Value / CERN Core)**

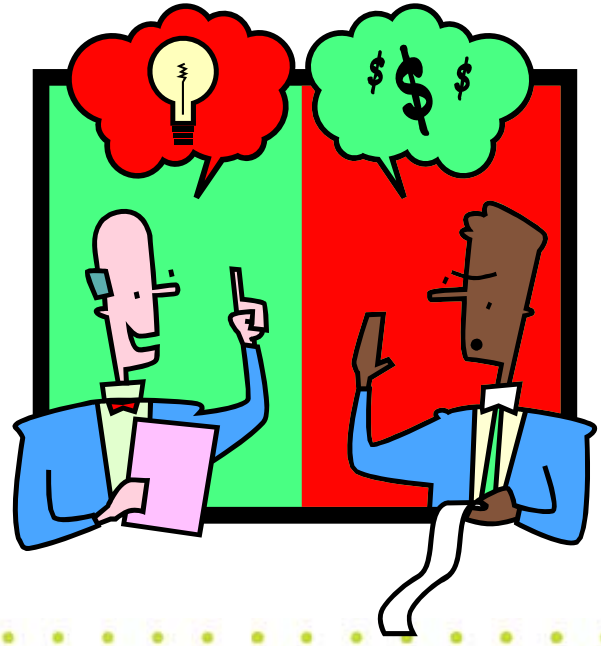
One year after Frascati

- **Vancouver 07/06**
  Major Goals Achieved after 7 months:
  - **Detailed conceptual design**
  - **90% of cost estimate (WBS) available**

Our first look at the total project cost

- **Valencia 11/06**
  Original goal: presentation of 1st draft RDR with cost

Producing the Design and Cost Estimate



RDR matrix

Area Systems

e- source	e+ source	Damping Rings	RTML	Main Linac	BDS
	Kiriki	Gao	ES Kim	Hayano	Yamamoto
		Guiducci		Lilje	Angal-Kalinin
Brachmann	Sheppard	Wolski	Tenenbaum	Adolphsen	Seryi
Logachev		Zisman		Solyak	

Technical Systems

Vacuum systems	Suetsugu	Michelato	Noonan
Magnet systems	Sugahara	Bondachuk	Thomkins
Cryomodule	Ohuchi	Pagani	Carter
Cavity Package	Saito	Proch	Mammosser
RF Power	Fukuda		Larsen
Instrumentation	Urakawa	Burrows	Ross
Dumps/Collimators	Ban	Densham	Markiewicz
Acc. Physics	Kubo	Schulte	

Global Systems

Ops. & Avail.	Teranuma	Elsen	Himel
Controls	Michizono	Simrock	Carwardine
Cryogenics	Hosoyama	Tavian	Peterson
CF&S	Enomoto	Baldy	Kuchler
Installation	Shidara	Bialwons	Asiri

RDR 'matrix' responsible for technical design and generating the cost estimate

RDR matrix

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Responsible for coordinating design

RDR matrix

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Technical requirements & specifications

RDR matrix

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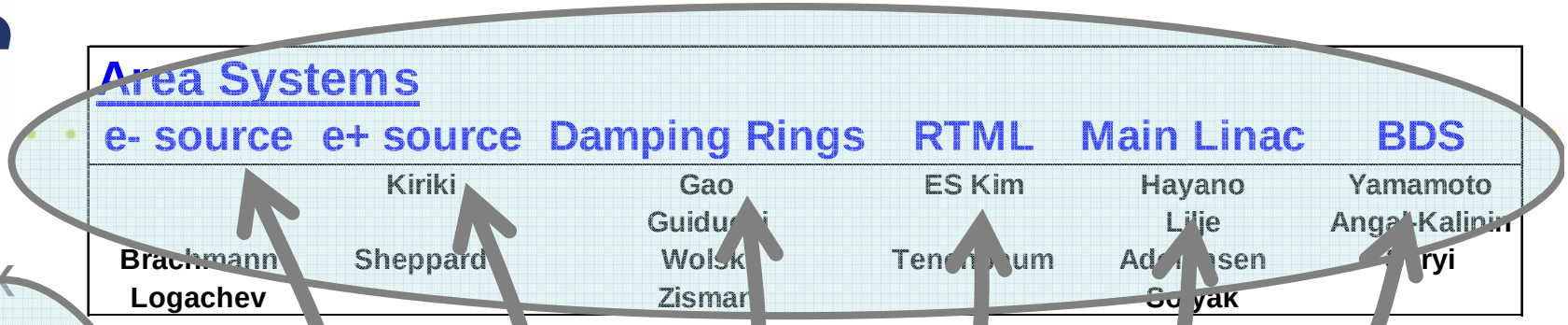
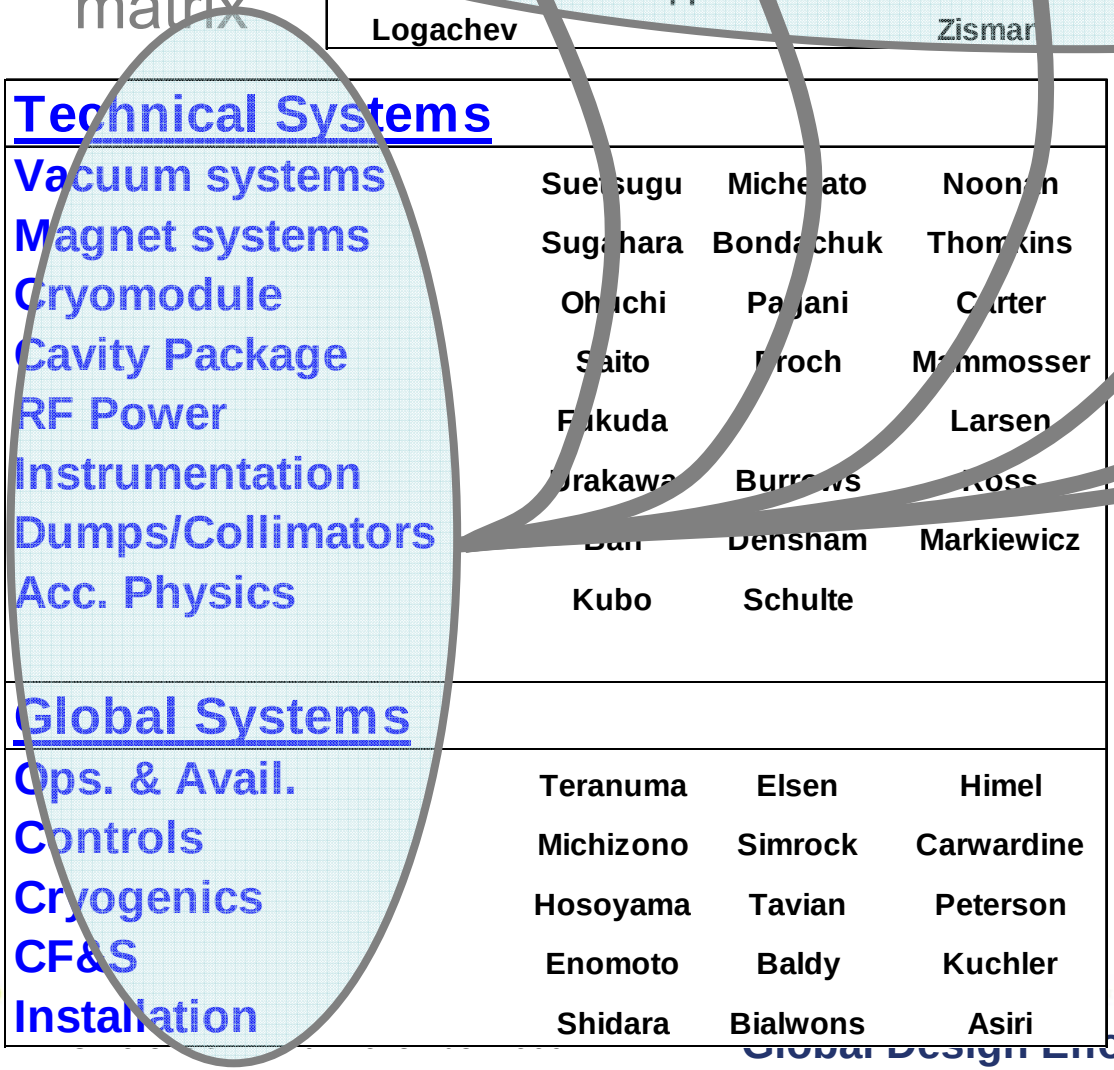
Responsible for cost estimates

RDR matrix





Cost supplied (rolled-up) to Area Systems

RDR matrix

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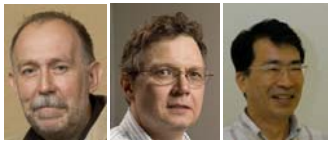
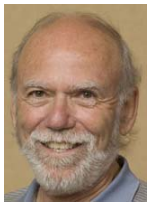
Bialowons
Garbincius
Shidara

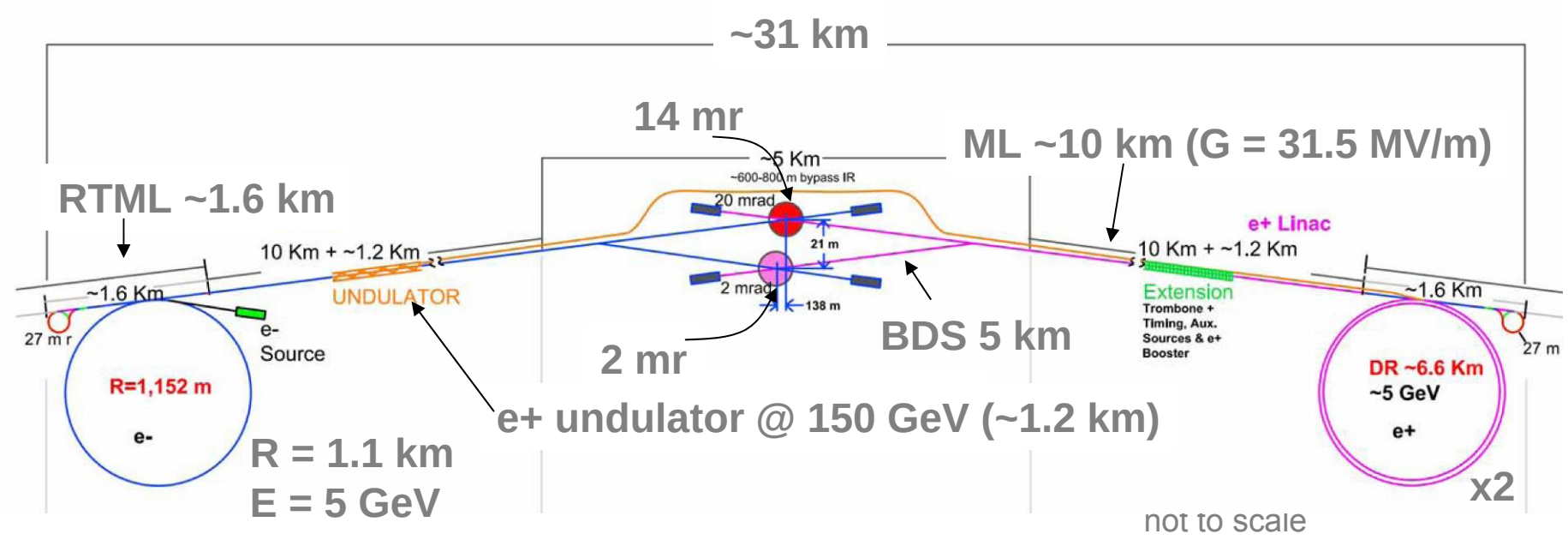


Regional Cost Engineers responsible for complete budget book



The Status at Vancouver (July '06)

Baseline Configuration



Configuration used for Vancouver cost estimate

fundamentally no different from Frascati BC, but much more detail design work

The Status at Vancouver (July '06)

System		Cost Estimates received for							Regional		
description	common	e-	e+	DR	RTML	ML	BDS	Exp	Am	Asia	Eur
e- Source		partial									
e+ Source			partial								
DR				**d.**							
RTML					partial						
Main Linac											
BDS							√ **b.**				
Com, Op, Reliab											
Control System	√	√	√	√	√	√	√				
Cryogenics - **a.**		√	√	partial	√	√	partial				
CF&S	√	√	√	√	√	√	85%**b**	√	√	√	√
Installation	√	√ f.	√ f.	√ f.	√ f.	√ f.	√ f.				
Instrumentation	√	√	√	√	√	√	√				
Cavities				√					√		√
Cryomodules		g.	g.	√	g.	g.			√	√	√
√	√	√	√	√	√	√			√	√	√
			d.			90%**b**					
√	√	√	√	√		√					
	c.√	√	√ d.	√	√	√					

Rough 1st iteration

Not quite 100% but close

Main cost drivers available

P. Garbincius

Result of Vancouver

Not! to scale!

- Initial rough cost estimate too high
  - **Not too surprised**
- Begin design and cost iteration
  - **Identify cost drivers**
- Cost estimate not as ‘mature’ as hoped
  - **Clear than more time will be needed to push back on costs**
- ~3 month delay to schedule
  - **Draft RDR+cost to be published at Beijing Feb. 07**

From Vancouver to Valencia:

Saving Money

Approach to Cost Reduction

Cost Reduction

- Design Scope
- Component Costs
- Physics Scope

No big ticket items!

Just lots of ≤1% effects

Approach to Cost Reduction

Design Scope

Component Costs

Physics Scope

Approach to Cost Reduction

Design Scope

Component Costs

Physics Scope

- Performance driven design
- Identify cheaper machine design (layout) modifications
- Understand Cost – Performance trade-offs
  - **Mostly associated with risk**
- Area System Orientated

Approach to Cost Reduction

Design Scope

Component Costs

Physics Scope

- Review component-level costs
- Identify ‘conservative’ estimates
  - **Push back on estimates**
  - **Mass quantity reductions etc.**
- Design cost savings
  - **Simplification of designs**
  - **Cost saving alternatives**
- Technical System orientated

Approach to Cost Reduction

Design Scope

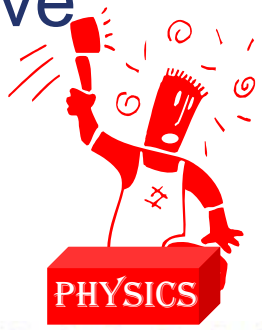
- Energy
- Luminosity
- Upgradeability

Component Costs

- Least attractive option

Physics Scope

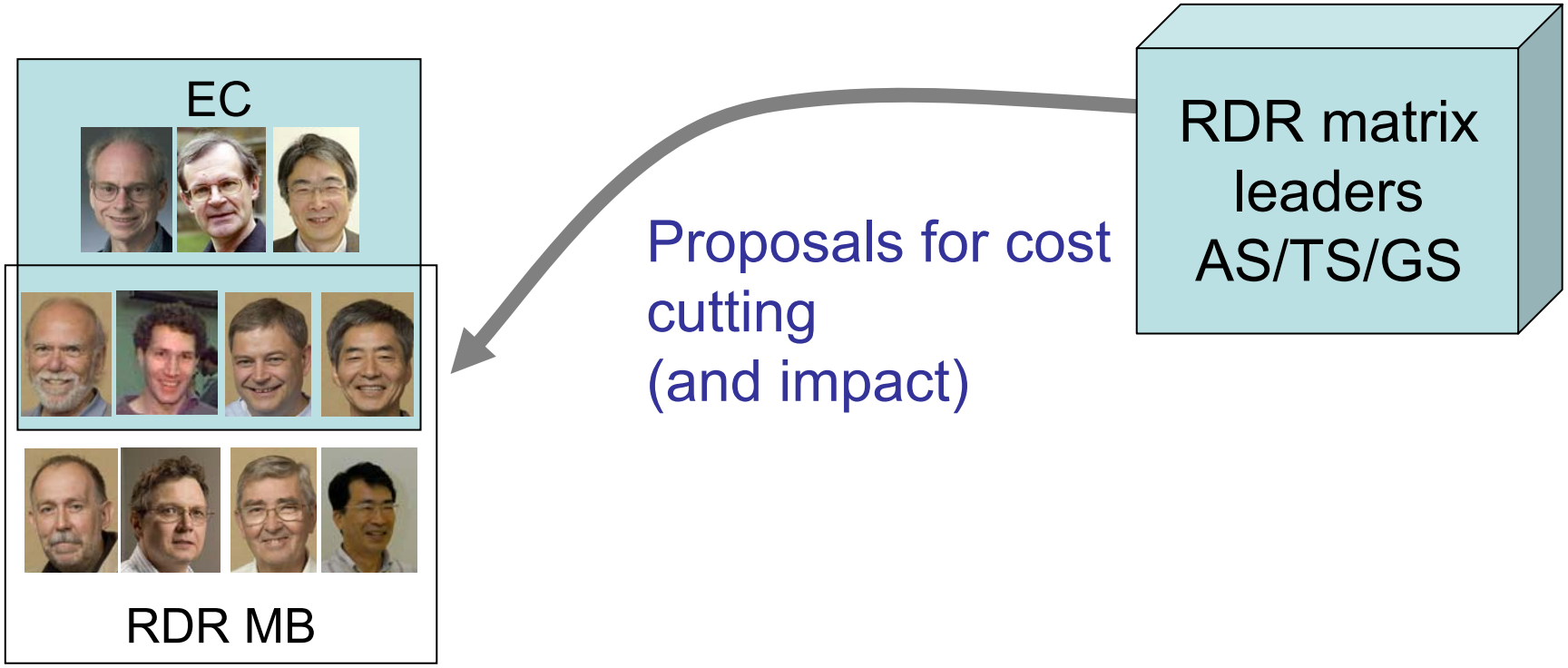
- Easiest way to save money!



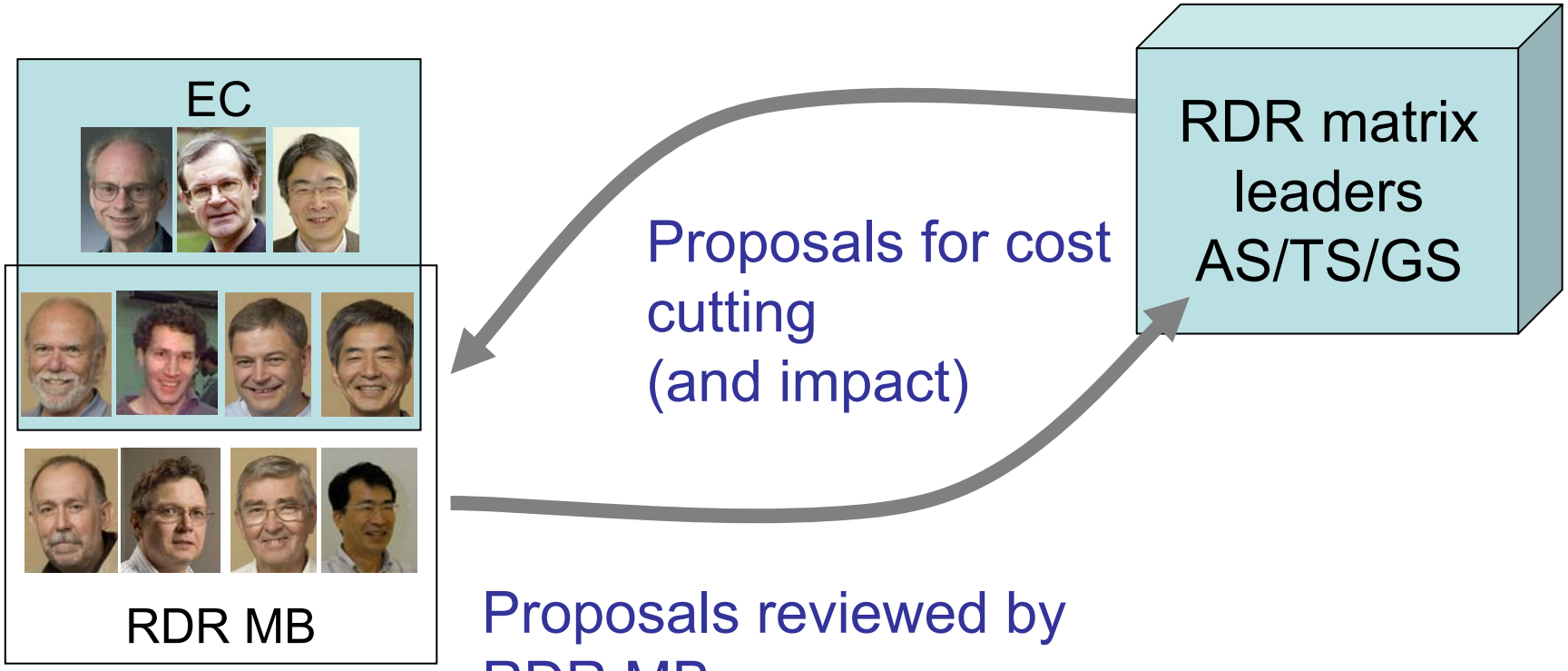
The Process

Your Management at work

The Process


EC
RDR MB
RDR matrix leaders AS/TS/GS
Proposals for cost cutting (and impact)
Your Management at work

The Process

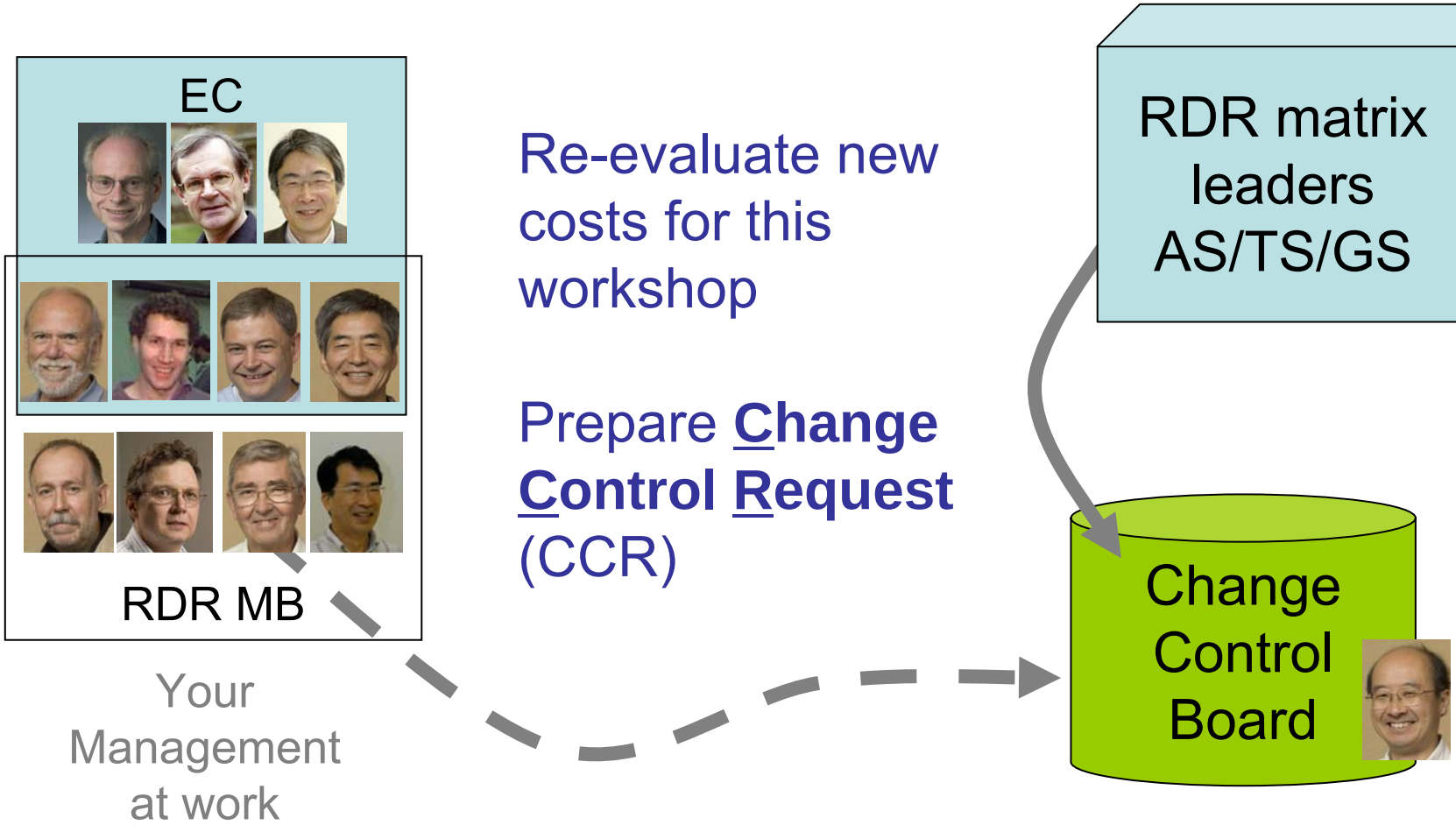


Your Management at work

Proposals reviewed by RDR MB

Revised list for ‘further study’

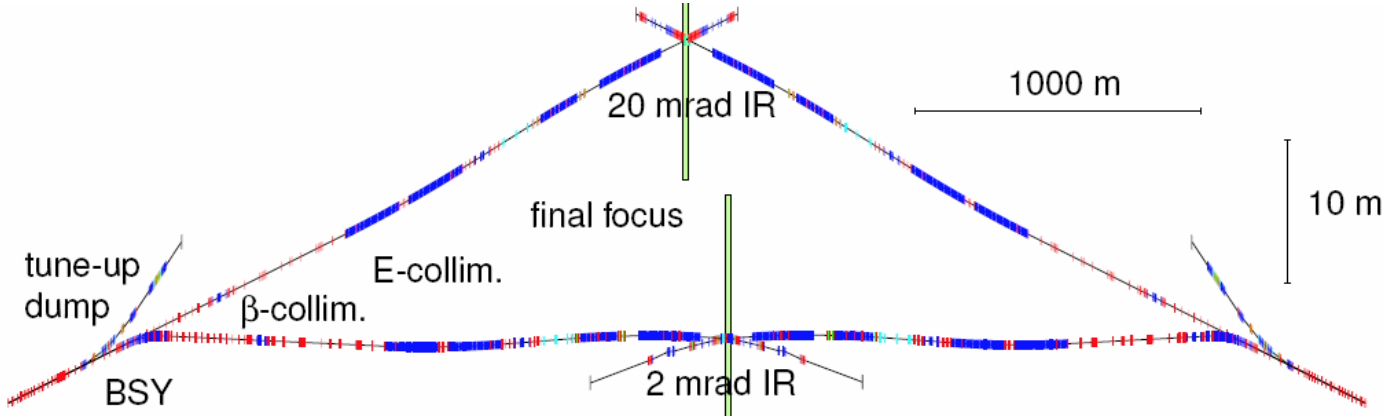
The Process


EC
RDR MB
Your Management at work
Re-evaluate new costs for this workshop
Prepare **Change Control Request** (CCR)
RDR matrix leaders AS/TS/GS
Change Control Board

Face-To-Face Meetings

31/8-1/9 KEK	Initial discussions on major design choices -Central injector concept -Positron source -CFS (tunnel)
20-23/9 KEK (GDE MAC / TTC)	Further discussions and planning -Cost reduction goals -Discussions of SCRF costs (TTC) -Planning for CALTECH, Valencia…
10-12/10 CALTECH	Major CFS review Review of AS cost reduction proposals

2×14mrad IR

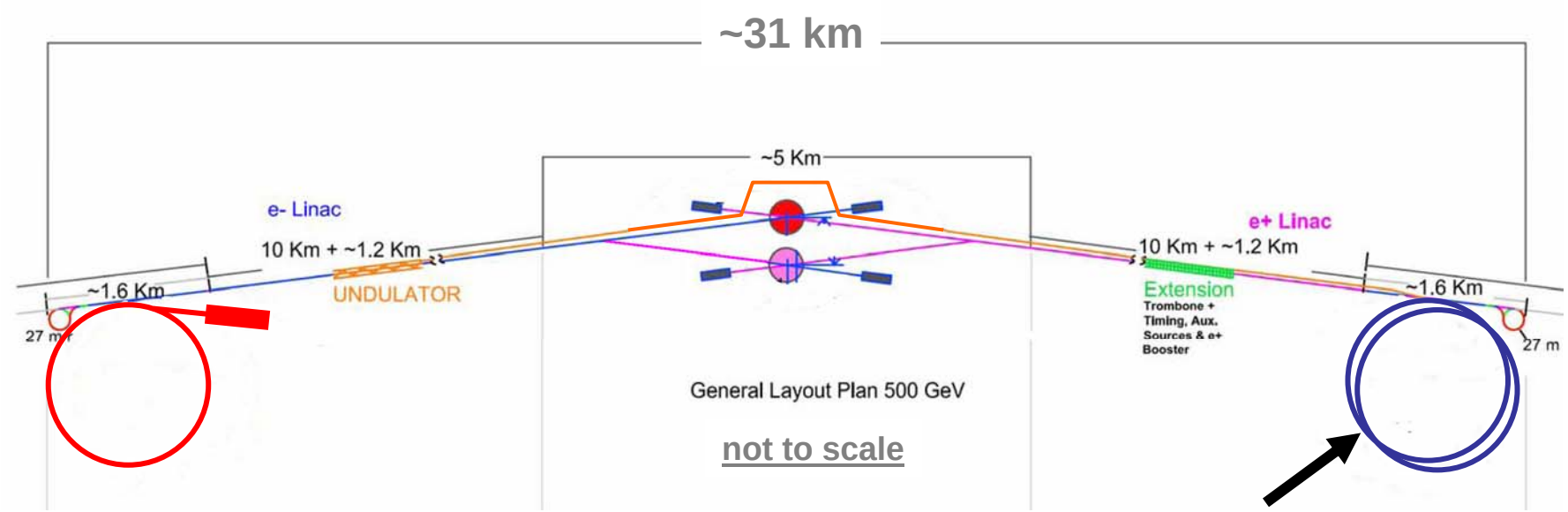


- Vancouver Baseline
  - **Two BDSs, 20/2 mrad, 2 detectors, 2 longitudinally separated IR halls**
- Present Baseline
  - **Two BDSs, 14/14 mrad, 2 detectors in single IR hall at Z=0**

- Cost-driven design modification
- 2mr IR significantly more expensive as 20mr
  - **Immature design**
- Discussions with MDI panel

Damping Ring

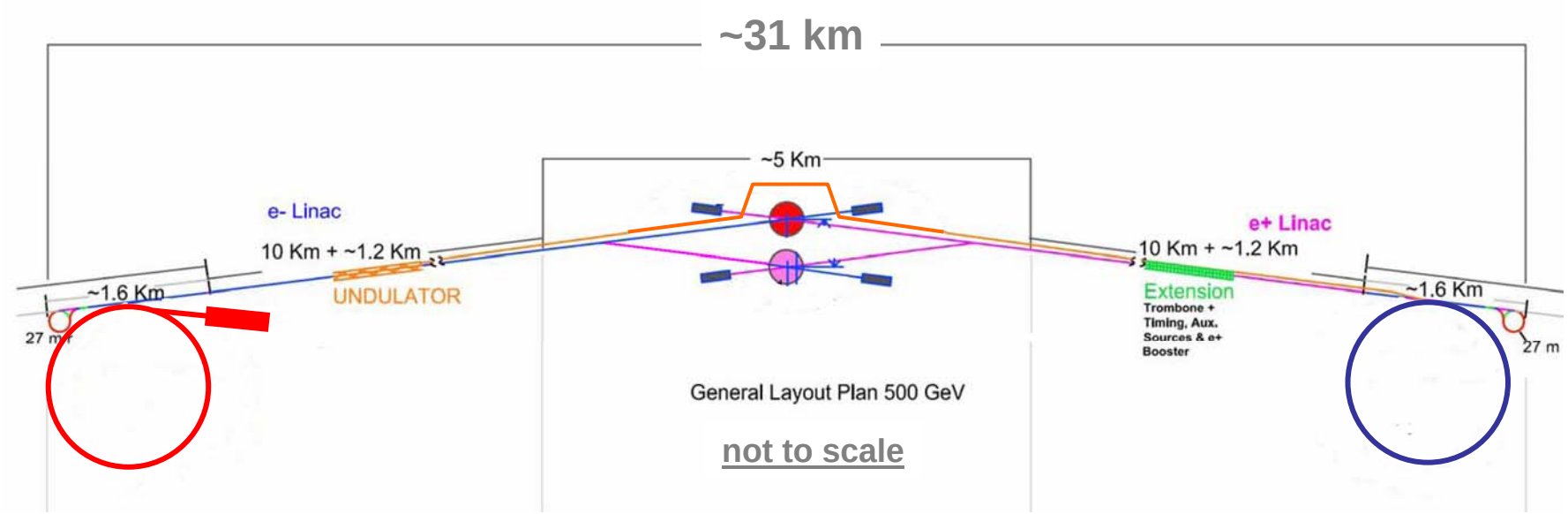
Baseline Configuration



Removal of second e+ ring

Damping Ring

Baseline Configuration

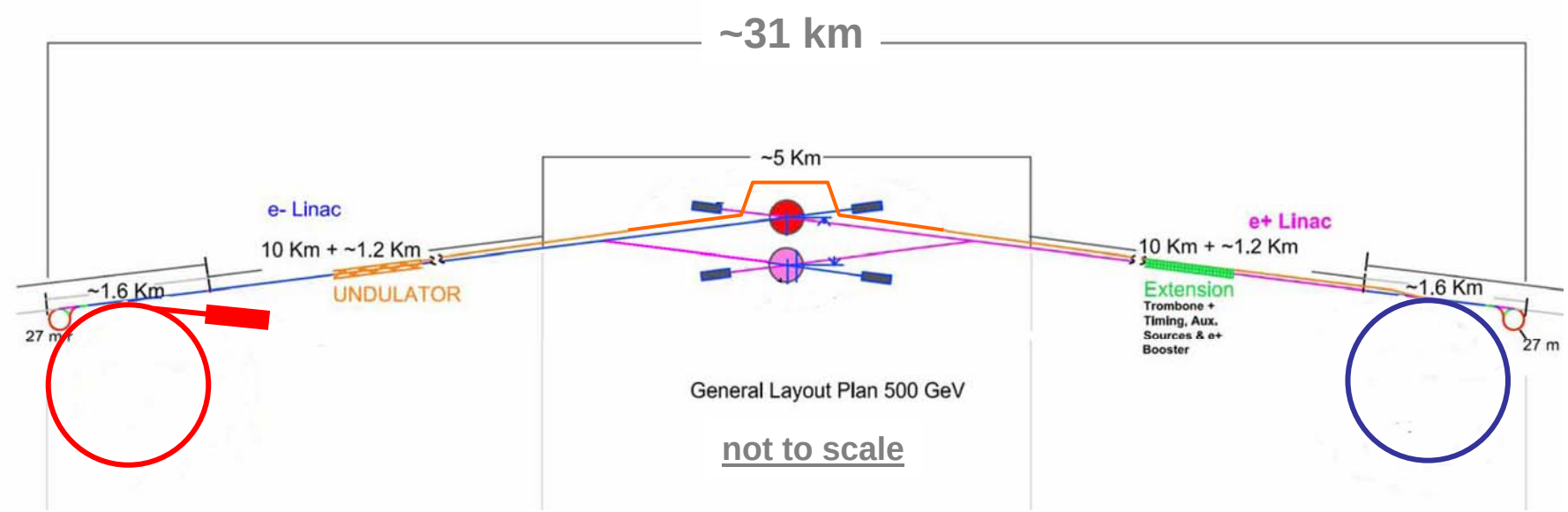


Removal of second e+ ring

simulations of effect of clearing electrodes on **Electron Cloud** instability suggests that a **single e+ ring** will be sufficient

Damping Ring

Baseline Configuration

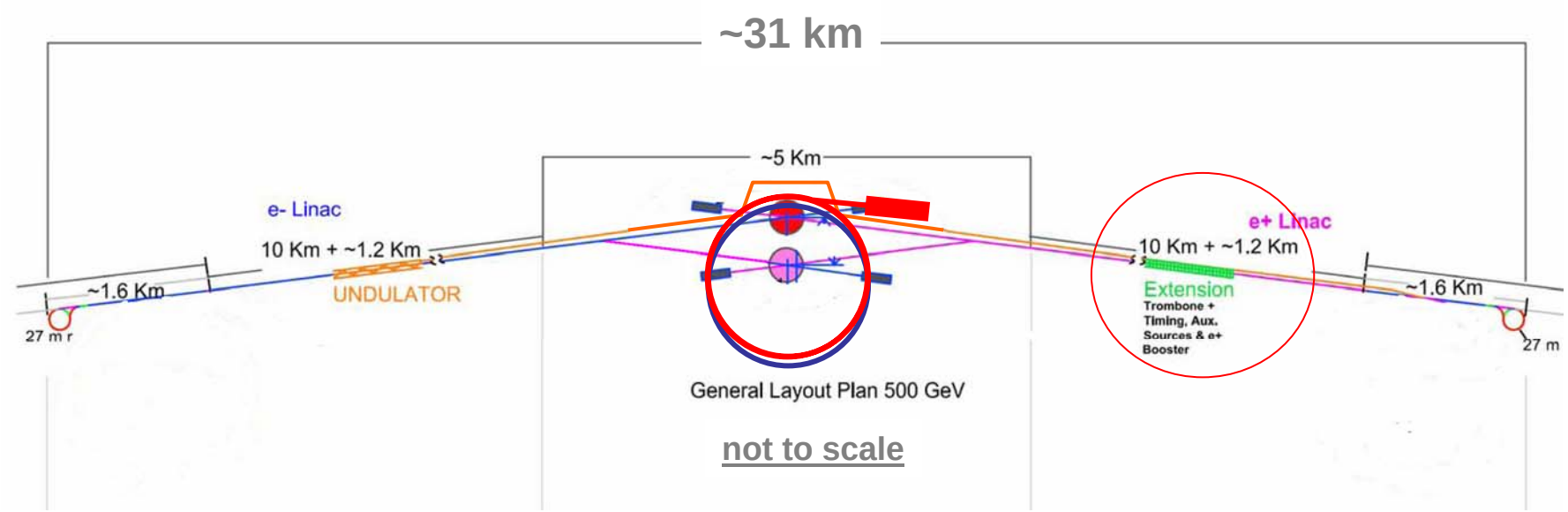


Centralised injectors

Place both e+ and e- ring in single centralized tunnel

Damping Ring

Baseline Configuration



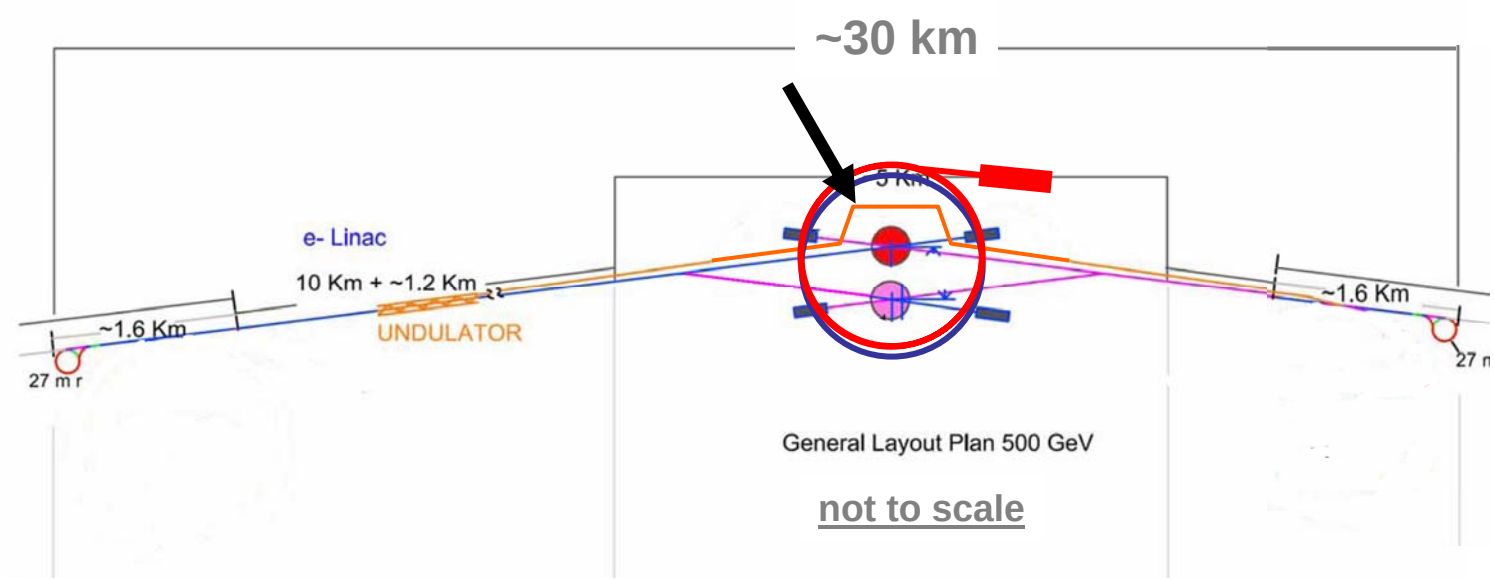
Centralised injectors

Place both e+ and e- ring in single centralized tunnel

Adjust timing (remove timing insert in e+ linac)

Damping Ring

Baseline Configuration



Centralised injectors

Place both e+ and e- ring in single centralized tunnel

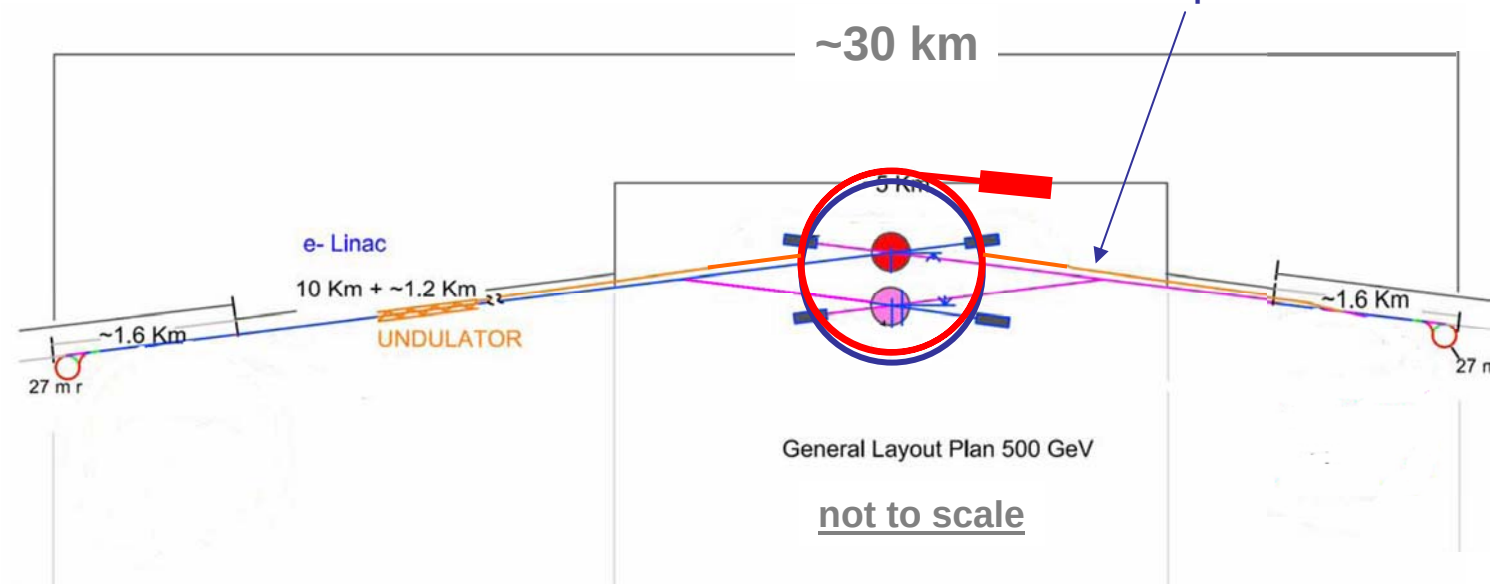
Adjust timing (remove timing insert in e+ linac)

Remove BDS e+ bypass

Damping Ring

Baseline Configuration

Long 5GeV low-emittance transport lines now required



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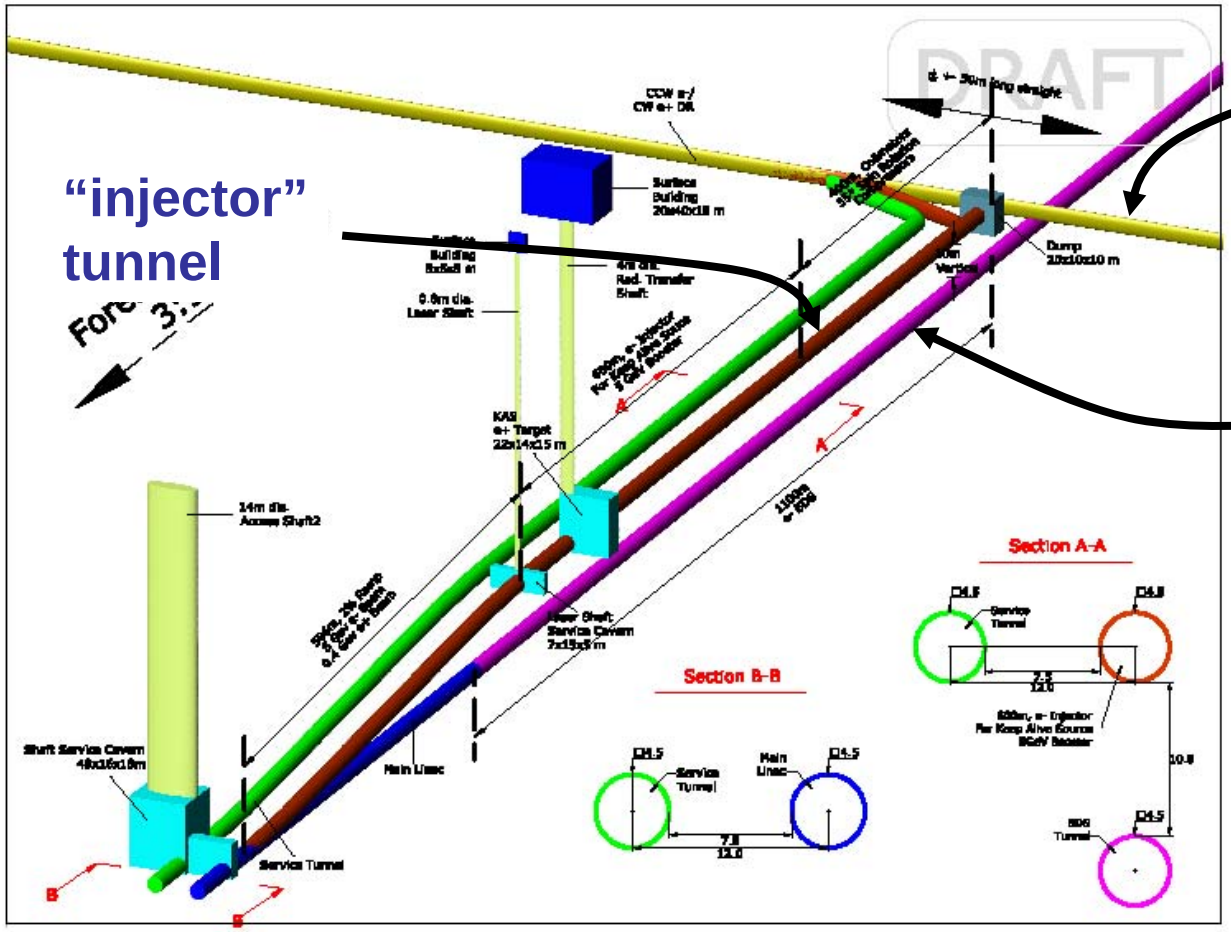
Central Injector



single DR tunnel (~10m elevation)

BDS tunnel

Complex re-design with impact on many sub-systems (and CFS!)

Coordinated effort with RDRMB, AS leaders, CFS and CCB

e^+ injection side

Examples of Cost-Driven Design Modifications being considered

	RDR MB	CCB
2×14mr IRs	supported	✓
central injectors	supported	✓
Removal of service tunnel	**rejected**	
conventional e+ source	**rejected**	
RF unit modifications (24 → 26 cav/klys)	supported	submitted
reduced RF in DR (6 → 9mm σ_z)	supported	in prep
DR race-track lattice (CFS)	supported	in prep
reduced static cryo overhead	supported	in prep
removal linac RF overhead	supported	in prep
single-stage bunch compressor	**rejected**	
e- source: common pre-accelerator	supported	in prep

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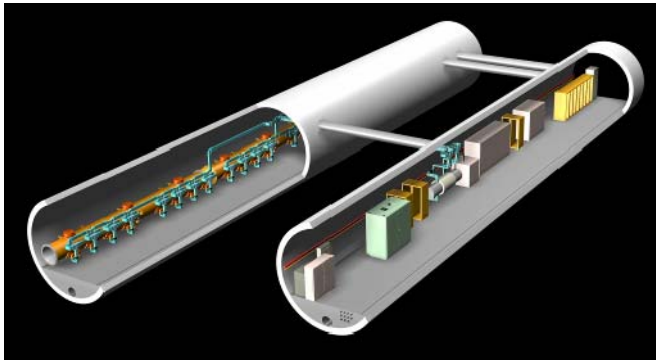
e- source: common pre-accelerator	supported	in prep

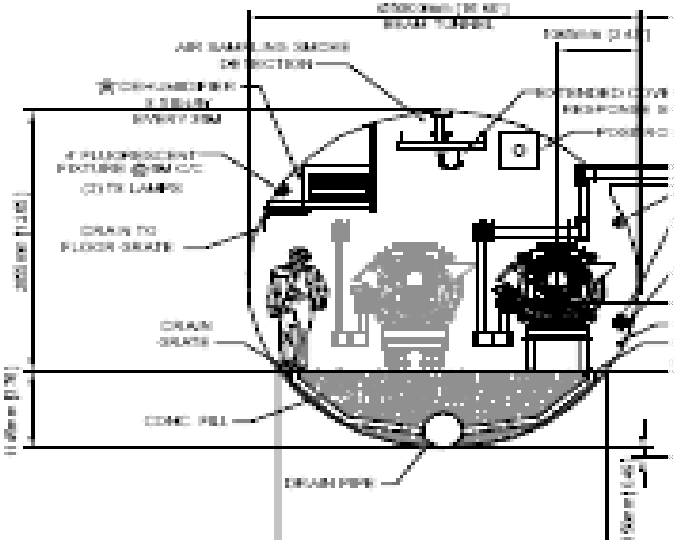
Current decisions are focused on cost baseline for the RDR

Many aspects will be re-evaluated (iterated) during the post-RDR Engineering Design Phase

This will include evaluation of 'Alternative' designs as R&D becomes mature.

CFS: A Special Case

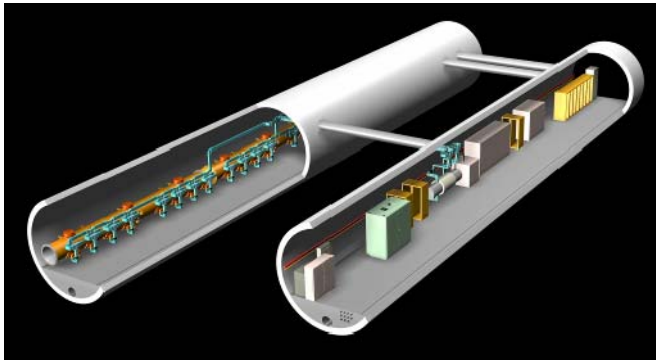


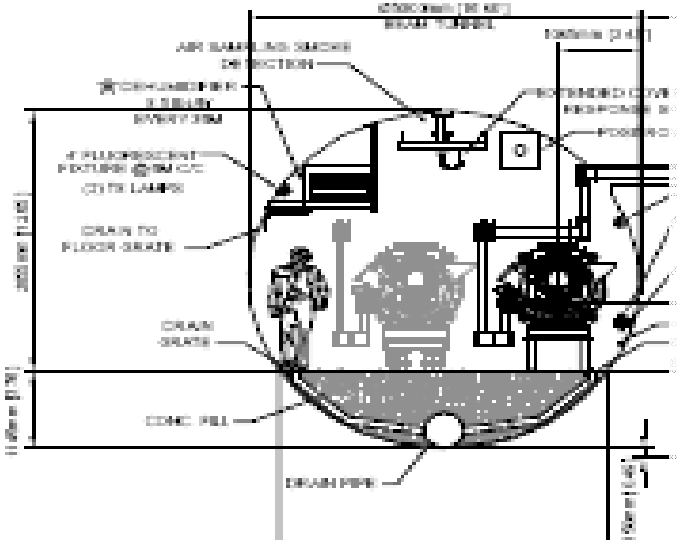


- Conventional Facilities & Siting is a major cost driver
- CFS review at CALTECH meeting
  - **close-loop with System Areas**
  - **Review of requirements**
  - **Identification of cost reduction measures**

→ CFS presentation by J-L. Baldy

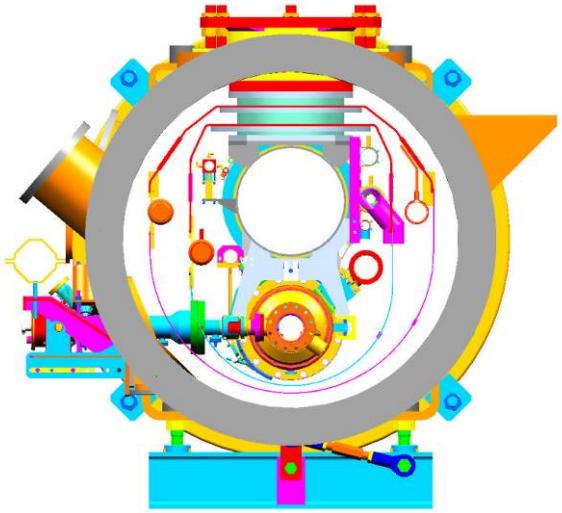
CFS: A Special Case





- Many significant costs savings identified
  - **Reduction of number of shafts**
  - **Reduced volume of underground construction**
- Impact of schedule being re-evaluated
  - **7 years original assumed**
- Power/Cooling requirements reviewed
  - **Dedicted meeting at SLAC (chaired by M. Ross)**
  - **Several cost saving items identified**
    - and reduction of site power requirement

SCRF: The Other Cost Driver



- Baseline remains fundamentally unchanged
  - **baseline gradient: 31.5 MV/m**
  - **cryomodule based on TESLA technology**
    - so-called 4th generation
- Challenge remains high-gradient R&D (yield)
  - **S0/S1 task force (more later)**

Our Goals for This Workshop

- Review status of design
  - **Including cost-driven modifications**
- Consolidate re-estimated costs
  - **Where do we stand after this iteration?**
- Interaction / discussion with Physics & Detector Community
  - **Understanding physics requirements / cost tradeoffs**
  - **Potential for cost-driven physics scope reductions**

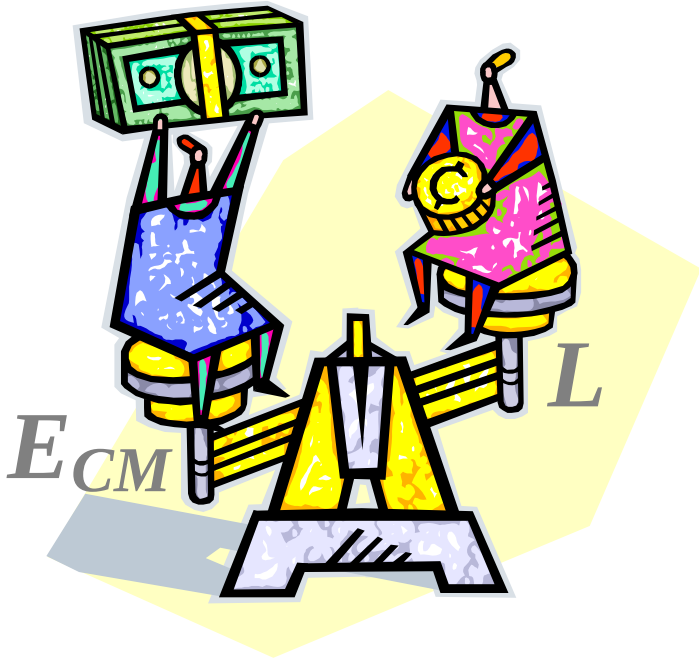
Our Goals for This Workshop (2)

- Review component cost estimates
  - **Look for further cost savings**
  - **Quantify cost-basis and 'quality of estimate'**
  - **Prepare for full cost review (SLAC, December)**
- Closed sessions:
  - **Wednesday: Area Systems (design reviews)**
  - **Thursday: Technical Systems (cost reviews)**
- Identify (by end of Workshop)
  - **If we have achieved our cost reduction goals, and if not**
  - **Where we have to push harder!**

So, What is the Cost?

Patience is a Virtue

Potential Physics Scope Reduction



Physics Scope Per Dollar

- Re-evaluating Physics Goals is part of Cost Awareness
- Physics 'cost drivers':
  - **Energy reach: re-defining 500 GeV**
  - **Peak Luminosity**
- Single IR (push-pull)
  - **not directly a physics scope issue**
- These will need to be fully discussed and coordinated with the Physics & Detector Community
  - **Physics Parameter Group**
  - **MDI panel**
  - **(WWS)**

→ Barish Friday plenary

Form Valencia to Beijing: The "Last 100 meters"

Plans until Beijing (Feb. '07)

- By the end of this workshop we must have
  - **consolidated design**
  - **new cost estimate**
  - **prioritized plans for addressing remaining (cost-driven) issues**
  - **schedule for CCB**
  - **Clear guidance and goals for writing the RDR**

Plans until Beijing (Feb. '07)

Plans until Beijing (Feb. '07)

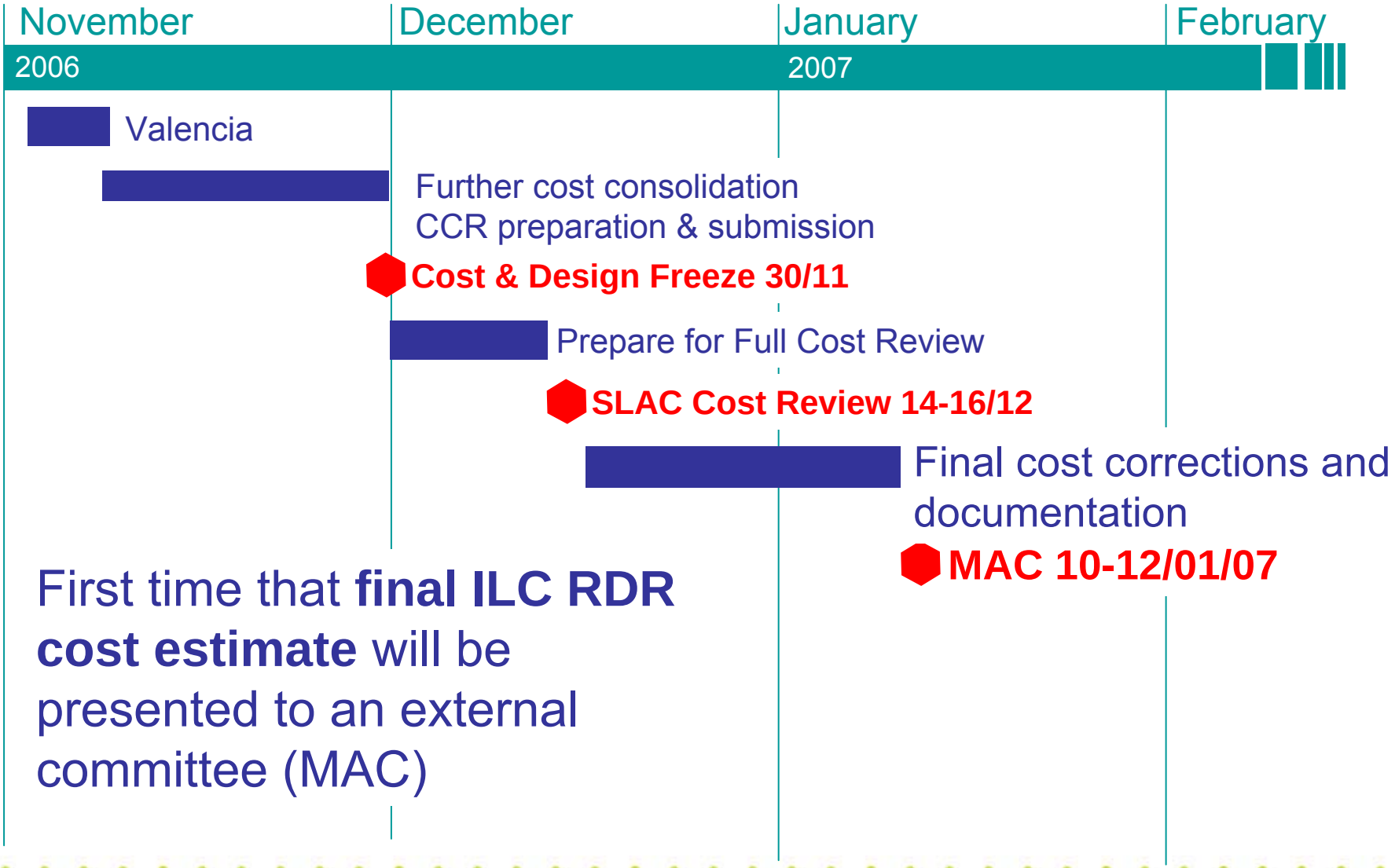
Full internal quasi-formal cost review

Including ‘external’ experts
(total 6: two from each region)

Preparation for post-RDR formal reviews

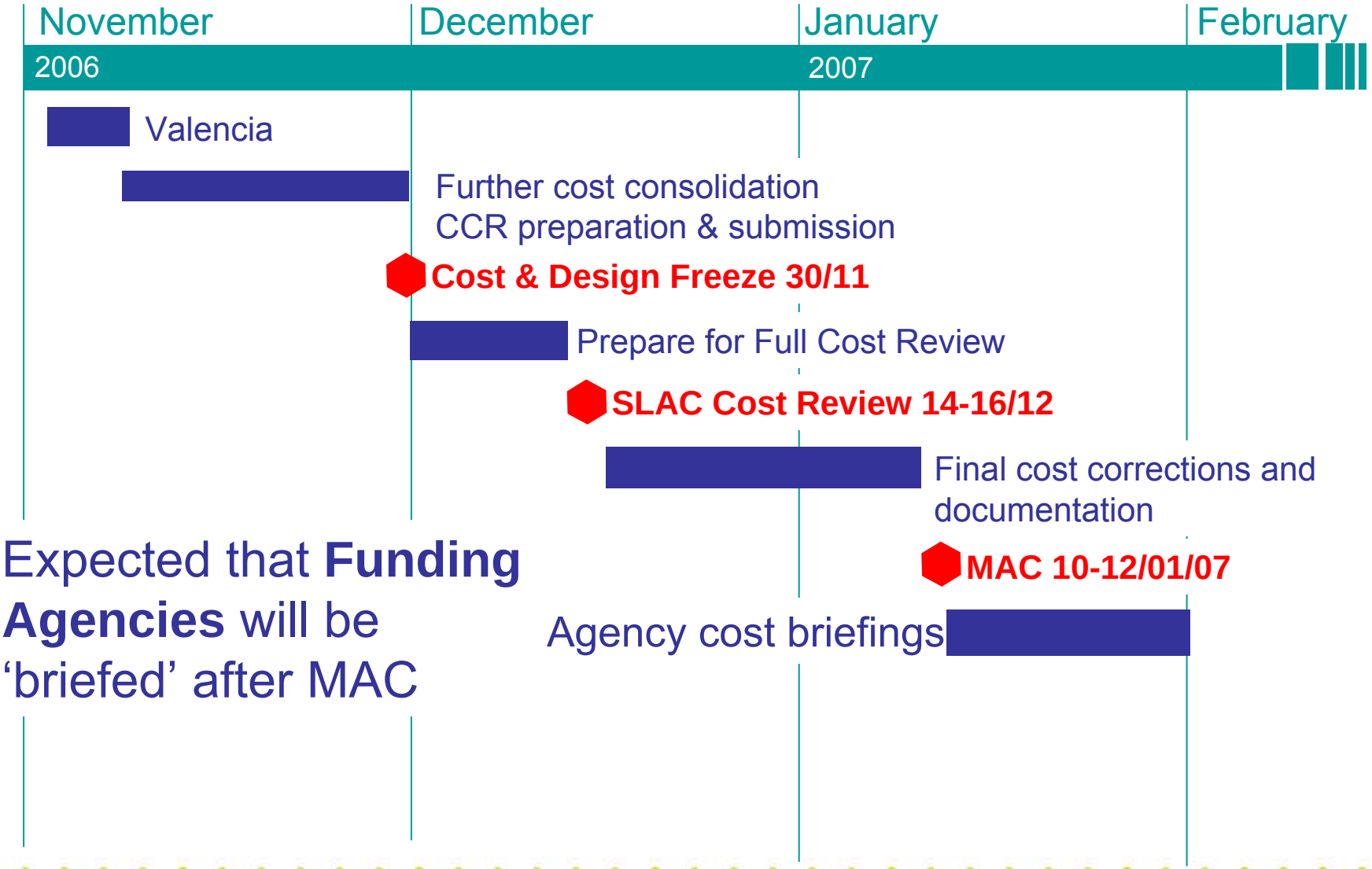
We begin to prepare for this today!

Plans until Beijing (Feb. '07)



First time that **final ILC RDR cost estimate** will be presented to an external committee (MAC)

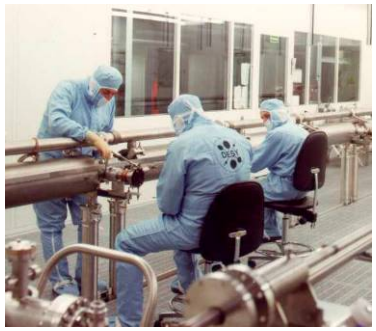
Plans until Beijing (Feb. '07)

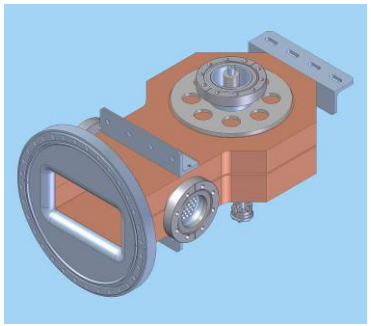
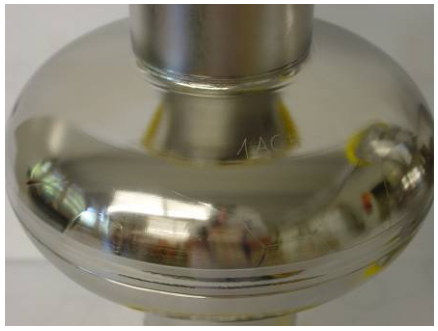


Expected that **Funding Agencies** will be 'briefed' after MAC

Plans until Beijing (Feb. '07)

ILC Global R&D:
"Driving the Money"




Mission of the Global R&D Board

- Coordinate worldwide, prioritized, proposal- driven, R&D efforts
- The goal is clear, the detailed means required resolution by the RDB of issues, for example:
  - **Level of coordination**
  - **Parallel efforts coordination, Regional needs**
  - **“Reviewing” role: Ideal vs specific R&D Program**
  - **Balance ILC/ILC Detectors issues**
  - **Goals, Timelines**
  - **Interfaces, RDB/DCB, RDB/Industrialization…**
- RDB have already successfully interfaced with US (DoE) and UK (PPARC) ILC R&D proposals.

The ‘S’ R&D Task Forces

S0
High-Gradient Cavities

S1
High-Gradient Cryomodule

S2
Test Linac

S3
Damping Ring

S4
Beam Delivery

S5…Sn

Priority: high

To address priority R&D items, RDB has convened several ‘task forces’.

S0-S3 will report on Friday AM GDE plenary

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S5…Sn

- Addresses current ‘poor’ yield for EP cavities
- Primary goal: establish parameters for routinely producing 35 MV/m EP’d cavities
  - **required ≥ 80% yield**

H. Hayano, T. Higo, L. Lilje, J. Mammosser, H. Padamsee, M. Ross, K. Saito

The ‘S’ R&D Task Forces

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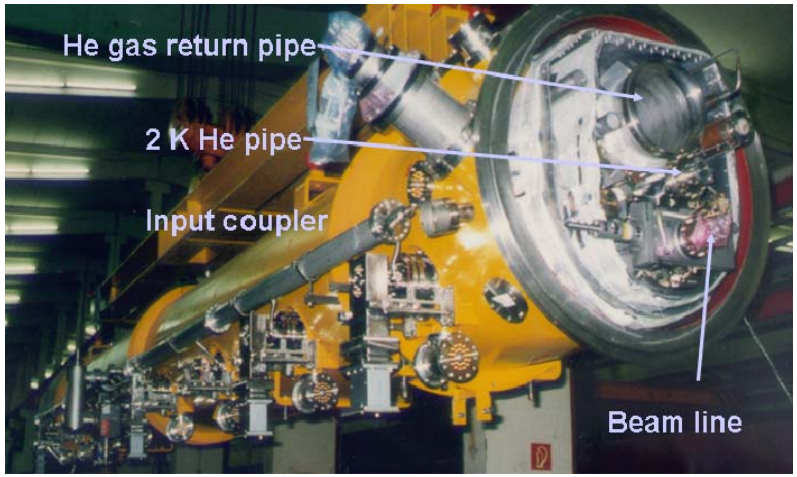

- Achieve 31.5 MV/m at a $Q_0=10^{10}$ as operational gradient
- in more than one module of 8 cavities
- including e.g. fast tuner operation and other features that could affect gradient performance

H. Hayano, T. Higo, L. Lilje, J. Mammosser, H. Padamsee, M. Ross, K. Saito

The ‘S’ R&D Task Forces

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S5…Sn

- Define requirements for ‘string tests’
  - **minimum: 1 RF unit**
- How many units required?
- Scope of string test

Hasan Padamsee (Co-Chair), Tom Himel (Co-Chair), Bob Kephart, Hitoshi Hayano, Nobu Toge, Hans Weise,

Consultants: Nagaitsev, Nikolai Solyak, Lutz Lilje, Marc Ross, Daniel Schulte

The ‘S’ R&D Task Forces

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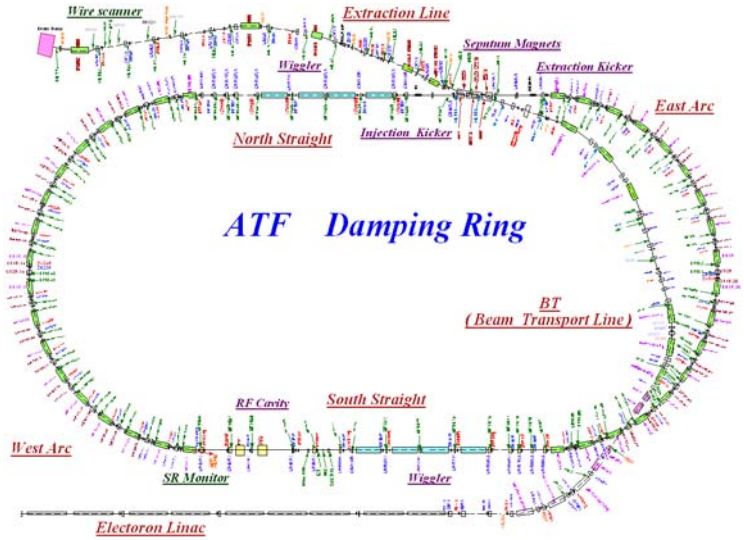

- Identification and prioritisation of DR related critical R&D
- Includes evaluation of available (and proposed) test facilities.

Andy Wolski,

The Last Bit

Valencia GDE Plenary Reports

Tuesday PM (Parallel with ECFA workshop)

GDE Opening Plenary Session I (14:30->16:45)	**Chairperson:** Barry Barish (*Caltech*) **Location:** ATENEO (ATENEO - Salón de Actos)
14:30	**RDR Management Board Overview** (35') — Kaoru Yokoya (*KEK*)
15:05	**Cost Status** (30') — Tetsuo Shidara (*KEK*)
15:35	**Main Linac System** (40') — Hitoshi Hayano (*KEK*)
16:15	**Damping Ring** (30') — Susanna Guiducci (*INFN*)

GDE Opening Plenary Session II (17:15->19:30)	**Chairperson:** Mitsuaki Nozaki (*KEK*) **Location:** ATENEO (ATENEO - Salón de Actos)
17:15	**BDS/MDI** (30') — Deepa Angal-Kalinin (*CCLRC Daresbury*)
17:45	**CF&S** (40') — Jean-Luc Baldy (*CERN*)
18:25	**RDB Report** (30') — Marc Ross (*FNAL*)
18:55	**EDMS** (30') — Maura Barone (*Fermilab*)

Valencia GDE Plenary Reports

Friday AM (Parallel with ECFA workshop)

GDE Final Plenary Session III (09:00->11:00)		**Description:** Tentative **Chairperson:** Jean-Pierre Delahaye (*CERN*) **Location:** ATENEO - Salón de Actos
09:00	**S0/S1** (30')	Hasan Padamsee (*Cornell*)
09:30	**S2** (30')	Thomas Himel (*SLAC*)
10:00	**S3** (30')	Andrzej Wolski (*Daresbury*)
10:30	Coffee Break	

GDE Final Plenary Session IV (11:00->13:00)		**Description:** Tentative **Chairperson:** Brian Foster (*Oxford*) **Location:** ATENEO - Salón de Actos
11:00	**CCB Report** (30')	Nobu Toge (*KEK*)
11:30	**Cost Review Report** (30')	Jean-Pierre Delahaye (*CERN*)
12:00	**RDR Writing** (20')	Nan Phinney (*SLAC*)
12:20	**Communications** (30')	

Valencia GDE Plenary Reports

Friday PM (Parallel with ECFA workshop)

GDE Final Plenary Session V (14:30->15:30)		**Description:** Tentative **Chairperson:** Gerry Dugan (*Cornell*) **Location:** ATENEO - Salón de Actos
14:30	**Post RDR** (30')	Brian Foster (*University of Oxford*)
15:00	**The Road to Beijing** (30')	Barry Barish (*Caltech*)

Summary

- First iteration design and costs at Vancouver workshop were too high
- Focus of interim period Vancouver-Valencia focused on cost reduction
  - **Machine design (scope) modifications**
  - **Component level cost reduction**
  - **Physics scope after discussion with Physics & Detector Community**
- Many design modifications being implemented
  - **Several proposals rejected by RDR MB**

Summary (cont.)

- This meeting now critical to consolidate new design and associated cost estimate
  - **Close loops**
    - Area Systems ↔ Technical Groups
  - **Understand cost status**
  - **Quality of cost basis**
  - **Preparation for SLAC cost review**
- Critical planning for presentation of **Draft RDR including Cost Estimate** at Beijing meeting (February 07)
- Global planning for critical R&D beginning
  - **Formation of 'S' task forces**

Last Words

- The GDE/RDR groups have made a phenomenal effort to develop the **Baseline Design** and associated **Cost Estimate**, but...
- There is still hard work ahead of us as we face the last '100m‘
- We must continue to **work together** to bring the RDR phase to a successful (and affordable) conclusion.

Thank you for your attention