Report on AD&I Meeting DESY 28-29.05.009

ILC-CLIC Developments

Nick Walker

ILC@DESY Project Meeting

03.07.2009

Rationale

- Next (important!) step in R&D Plan 'cost reduction' studies
- "Minimum Machine" document '08 deliverable
  - **Single tunnel (klystron cluster)**
  - **Central region integration (incl. e+ and e- sources)**
  - **Adoption of low-p parameter set (w/ travelling focus)**
- Additional elements for AD&I meeting:
  - **Renewed focus of gradient baseline**
  - **DRFS solution for deep single tunnel**
  - **300Hz 'stand-alone' e-driven positron source**
- AAP review: Need to establish 'project' and design team – better integration of CFS

DESY AD&I Meeting Summary Report

Summary report of the first meeting on Accelerator Design & Integration 28-29th May, DESY

5th June, 2009

Editors: Ewan Paterson (SLAC)
Marc Ross (FNAL)
Nick Walker (DESY)
Akira Yamamoto (KEK)

ILC-EDMS ID: D*879845

DRAFT

- Comprehensive summary report
- Table of SB2009 Working Assumptions
- List of Action Items for ALCPG

http://ilc-edmsdirect.desy.de/ilc-edmsdirect/file.jsp?edmsid=*879845

Approach

- Top-down seven-point proposal by Project Management to AD&I group
- 2-day face-to-face 'plenary style' meeting
  - **Team-building**
    - re-focus TAG leaders on design issues
  - **PM always present**
    - different (for example) from Snowmass 2005 approach
- Attempt to construct 'consensus' of AD&I group towards
  - **Working Assumptions for interim studies**
    - Decisions made for evaluation work to proceed
  - **Further work / action items for ALCPG**

Attendance (AD&I Group)

Chris	Adolphsen	SLAC	Vic	Kuchler	FNAL
Deepa	Angal-Kalinin	CI	Frank	Lehner	DESY
Ian	Bailey	CI	Lutz	Lilje	DESY
Barry	Barish	GDE	Collomb	Norbert	CI
Wilhelm	Bialowons	DESY	Tsunehiko	Omori	KEK
Axel	Brachmann	SLAC	John	Osborne	CERN
Karsten	Buesser*	DESY	Ewan	Paterson	SLAC
Phil	Burrows*	JAI/OXU	Marc	Ross	FNAL
John	Carwardine	ANL	Tetsuo	Shidara	KEK
Eckhard	Elsen	DESY	Nikolay	Solyak	FNAL
Atsushi	Enomoto	KEK	Junji	Urakawa	KEK
Shigeki	Fukuda	KEK	Nicholas	Walker	DESY
Peter	Garbincius	FNAL	Barbara	Warmbein	DESY
Susanna	Guiducci	INFN	Hans	Weise	DESY
Hitoshi	Hayano	KEK	Akira	Yamamoto	KEK
Jim	Kerby	FNAL	Kaoru	Yokoya	KEK
WebEx:					
Rongli	**Geng**	**JLab**	**Tom**	**Lackowski**	**FNAL**
Camille	**Ginsburg**	**FNAL**			

*) Physics & Detector (MDI) representatives

SB-2009 Proposal (PMs)

1. A Main Linac length consistent with an optimal choice of average accelerating gradient
   - **RDR: 31.5 MV/m, to be re-evaluated**

2. Single-tunnel solution for the Main Linacs and RTML, with two possible variants for the HLRF
   - **Klystron cluster scheme**
   - **DRFS scheme**

3. Undulator-based e+ source located at the end of the electron Main Linac (250 GeV)
   - **Capture device: Quarter-wave transformer**

SB-2009 Proposal (PMs)

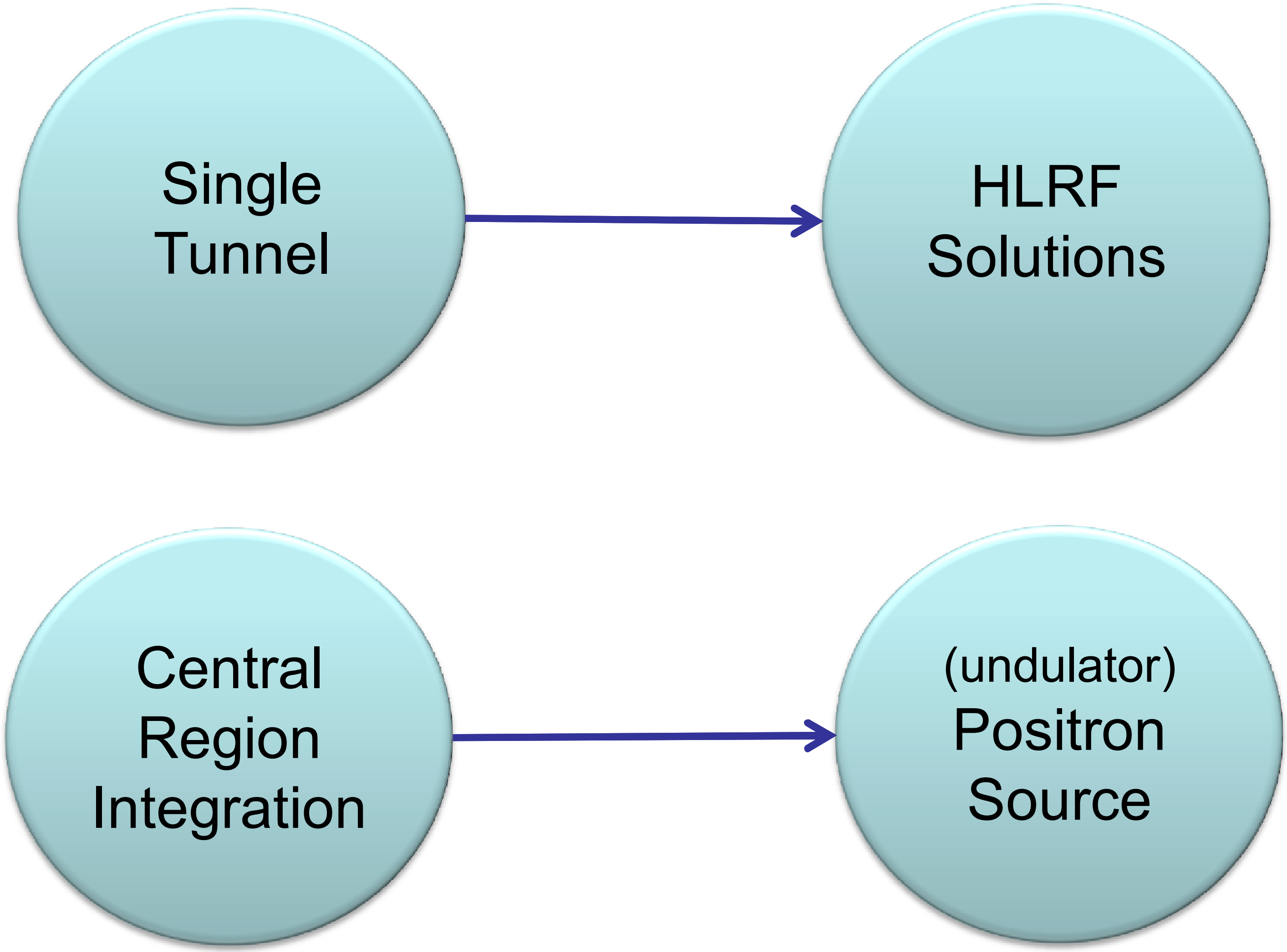
4. Reduced parameter set (with respect to the RDR)
   - **n_b = 1312 and a 2ms RF pulse (so-called "Low Power")**

5. Approx. 3.2 km circumference damping rings at 5 GeV
   - **6 mm bunch length**

6. Single-stage bunch compressor
   - **compression factor of 20**

7. Integration of the e+ and e- sources into a common "central region beam tunnel", together with the BDS.

Primary Issues



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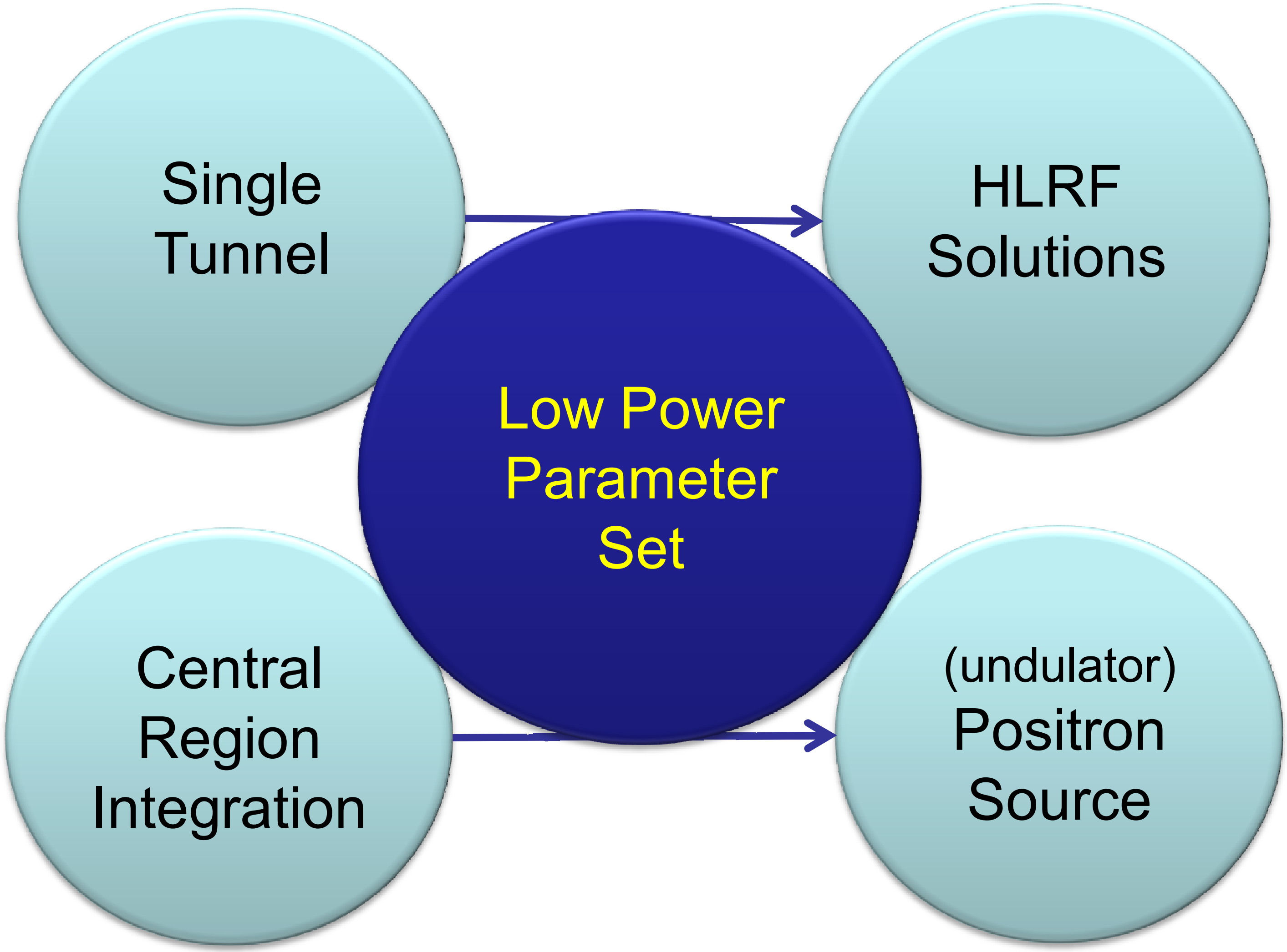

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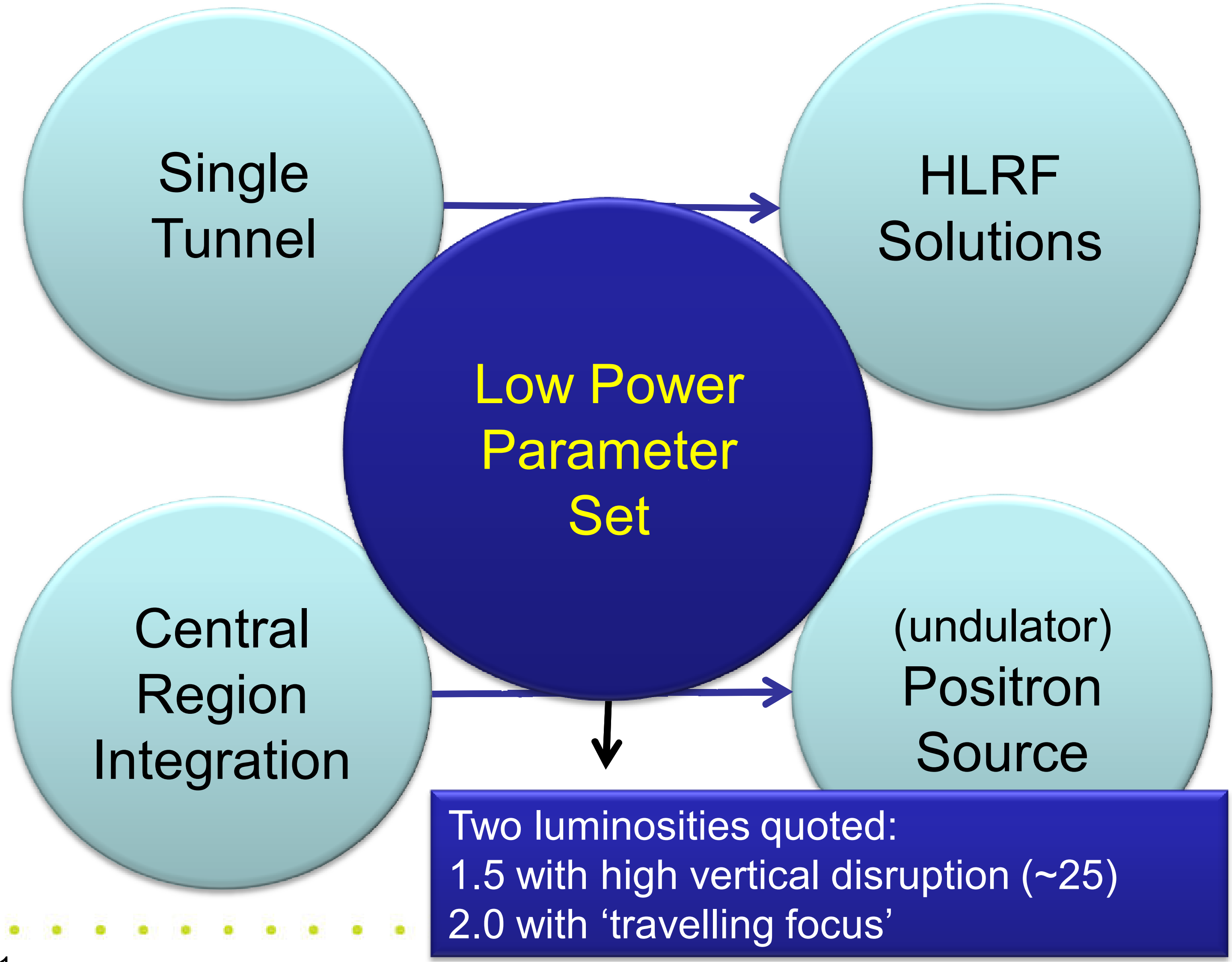

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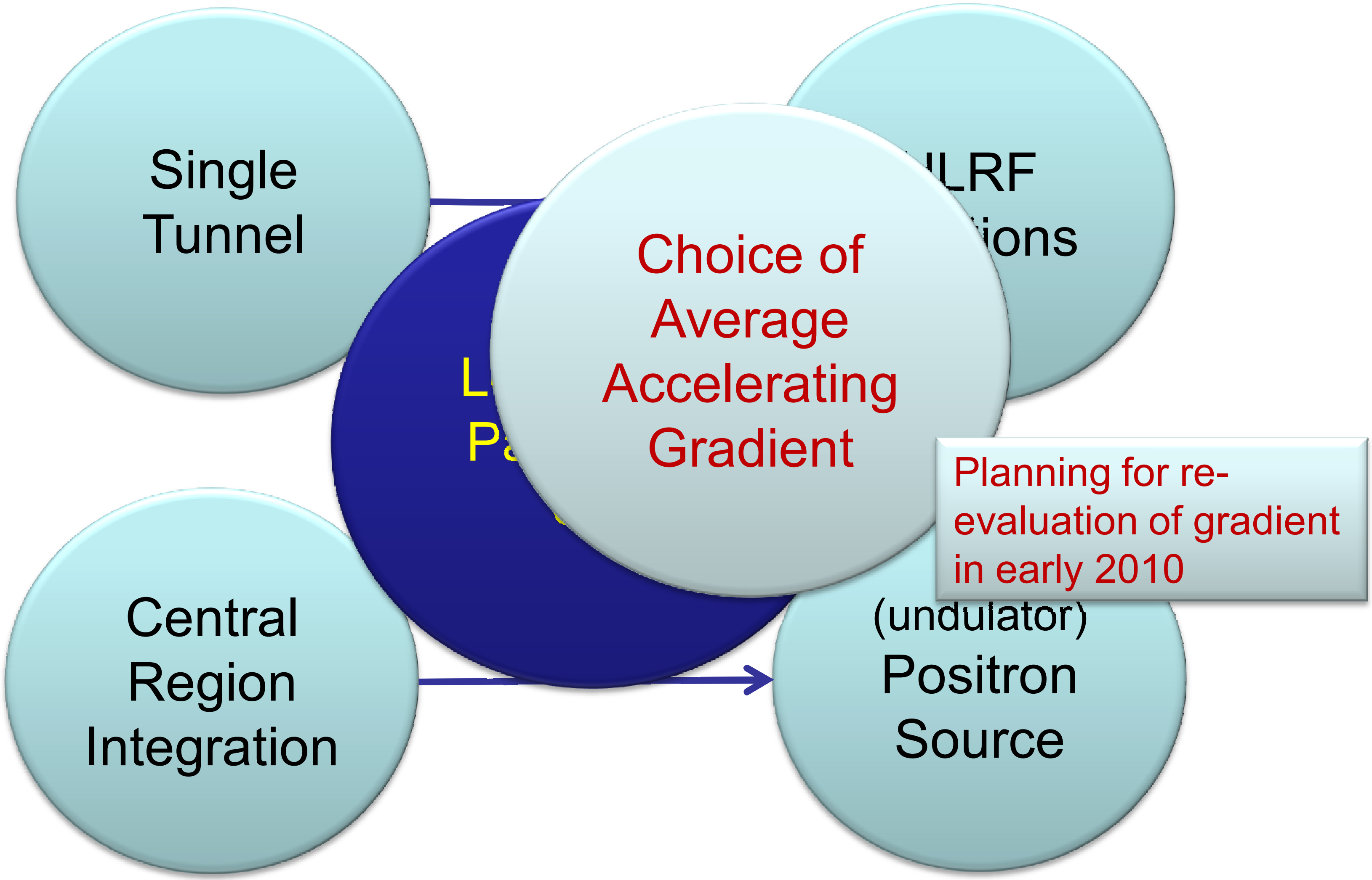
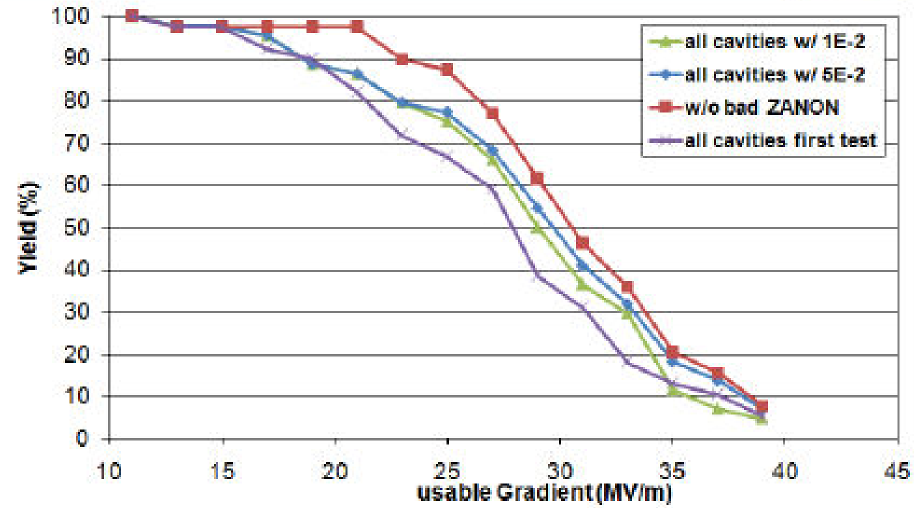


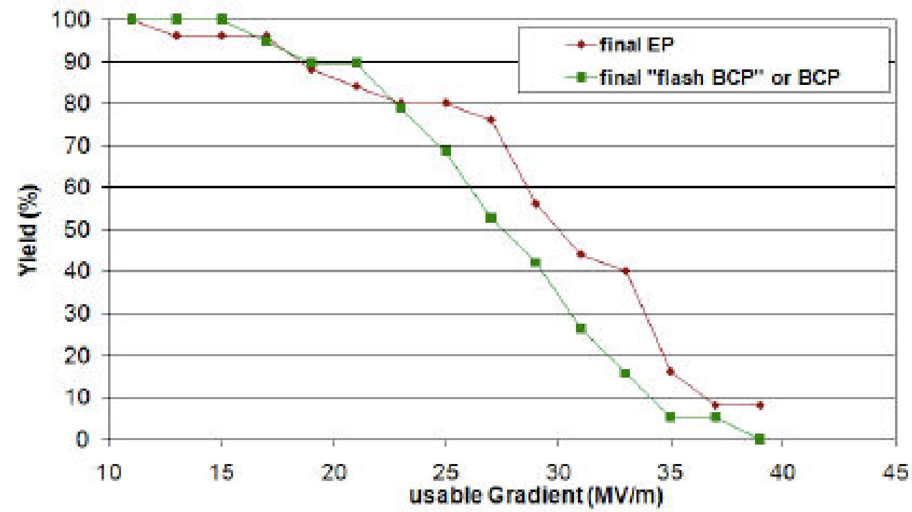
Gradient Yield

- Critical parameter is ‘Production Yield’ at ~35 MV/m
- A primary cost-driver for collider design
- Fabrication (production) models
  - **Suitable definition of yield for cost model**
  - **Justifiable definition for risk assessment**
- World-wide cavity data still rather sparse
  - **Clear need to consolidate all nine-cell results on a clear and comparable basis**

Progress Integrated at DESY

- cavity progress can be evaluated on the basis of **44 measured cavities**
  - 23 cavities w/o He tank
  - **21 cavities with He tank,** i.e. XFEL configuration
  - Approx. **60%** of the cavities with final **electro-polishing** (EP)
  - Approx. **25% with additional High Pressure Rinsing (HPR)** due to field emission (FE)
  - **Difference between first and last test** dominated by FE reduction
  - **Definition of radiation limit at** XFEL gradients not too critical
  - choice of final surface treatment impacts yield at higher gradients
- yield seems to depend on **steps after the final chemical treatment**; further improvement expected for series production





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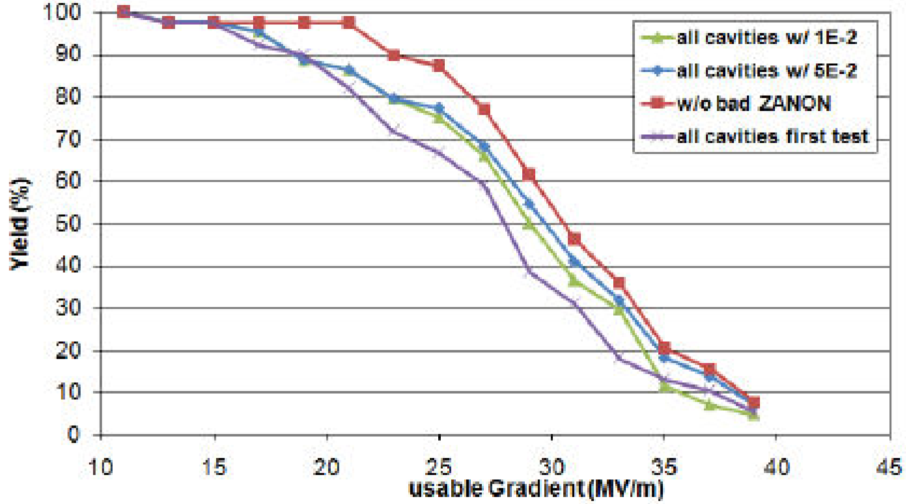
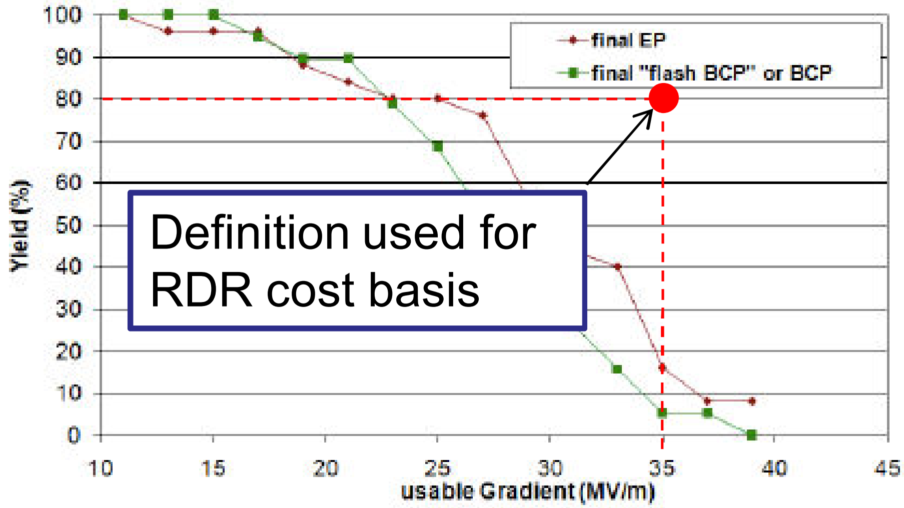


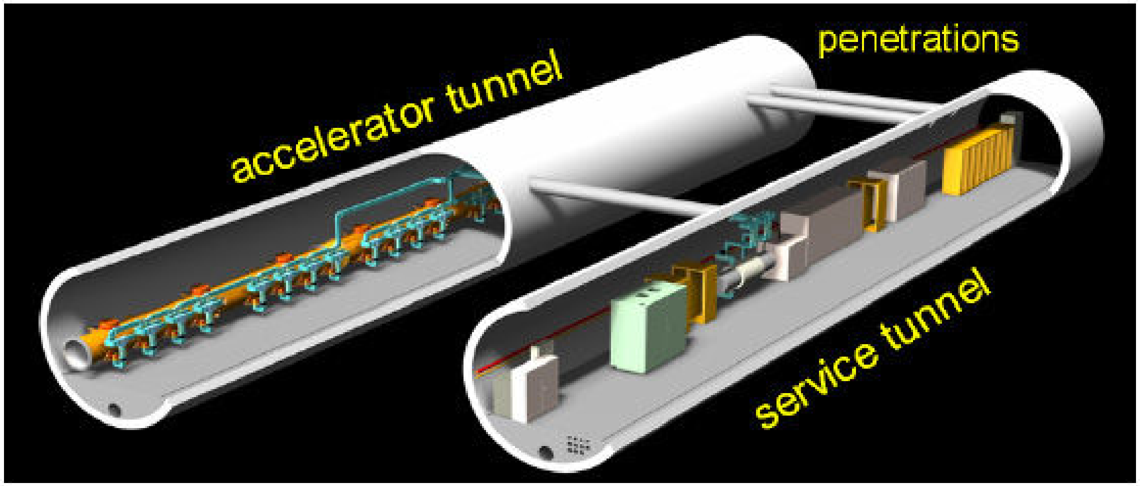


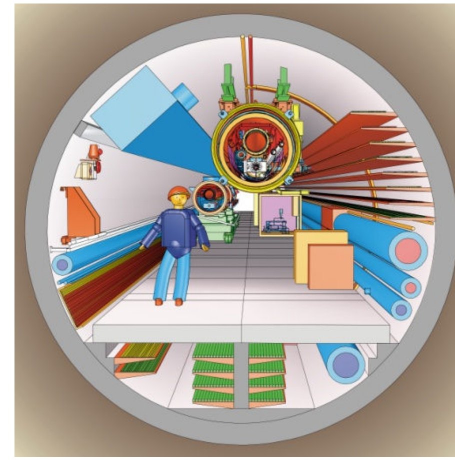
Cavity Gradient Discussions

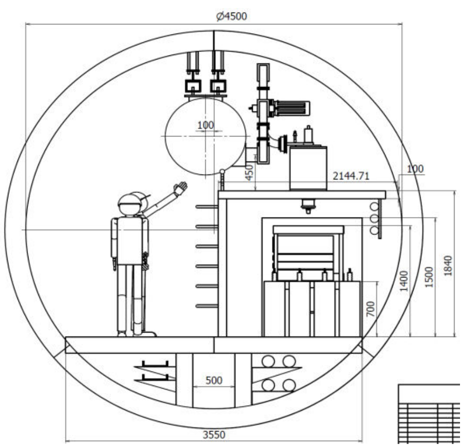
- Led by Rongli Geng (JLab) with a status report
- Followed by Camille Ginsburg (FNAL) with her presentation on the current status on the data base and further international data accumulation
  - **Essential collaborators from each lab (names confirmed after the meeting).**
    - FNAL/ANL: Camille Ginsburg
    - DESY: Sebastian Adehold
    - Jlab: Rongli Geng
    - Cornell: Zac Conway
    - KEK: Yasuchika (Kirk) Yamamoto
    - Others: TBD

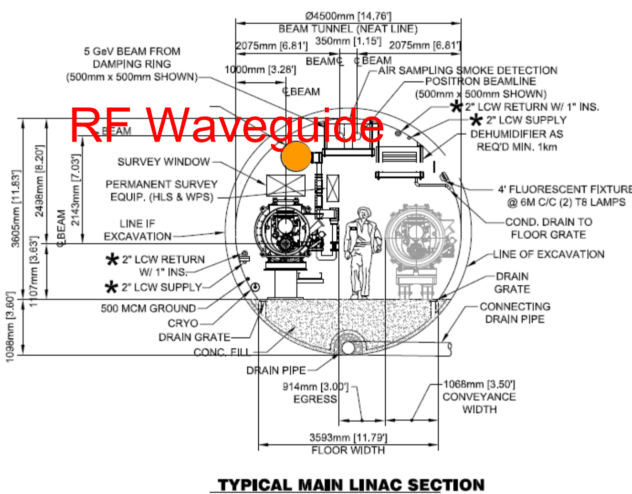
  Provide cavity results for centralised database
- Start to understand how to best to (re-)consider the choice of baseline gradient yield.

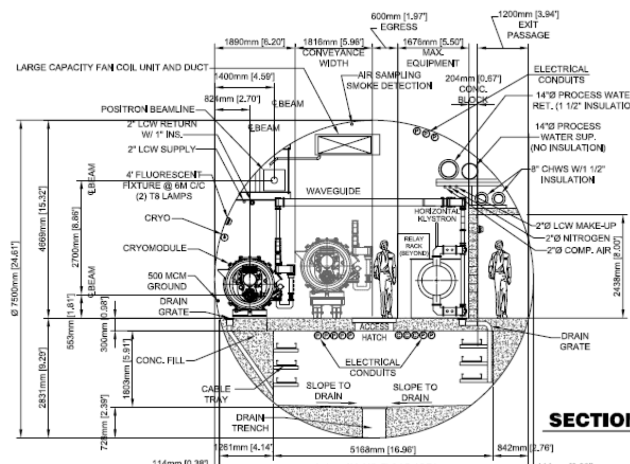
One Tunnel Variant











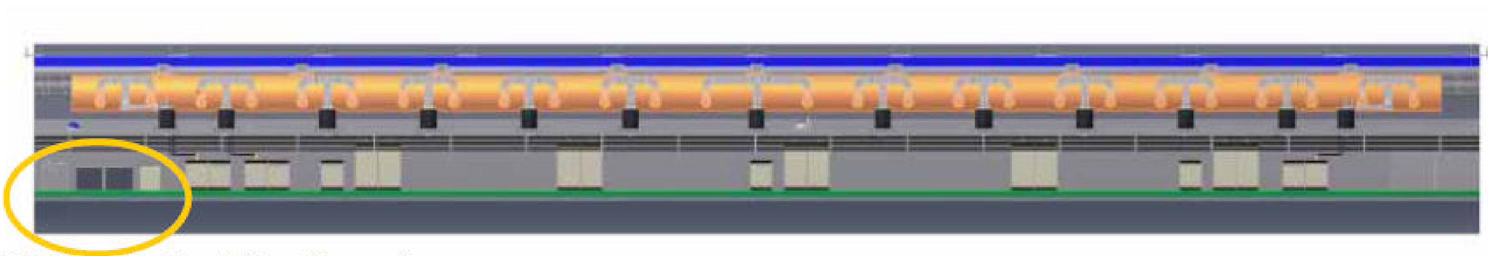
High-Level RF Solution

- Seen as critical component for one-tunnel solution.

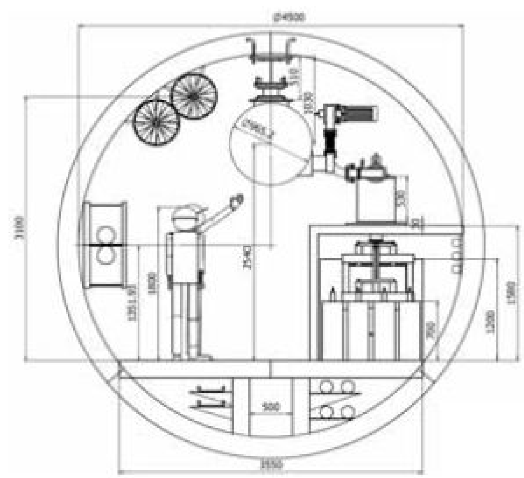
- Two solutions:
  - **Klystron Cluster concept**
    - RDR-like 10 MW Klystrons/modulators on surface
    - Surface building & shafts every ~2 km
    - Novel high-powered RF components (needs R&D)
  - **Distributed RF Source**
    - Small ~700kW klystrons+modulators in tunnel
    - One klystron per two cavities
    - ~3800 klystrons per linac
    - Challenge is design for manufacture (cost reduction)

Distributed RF Source

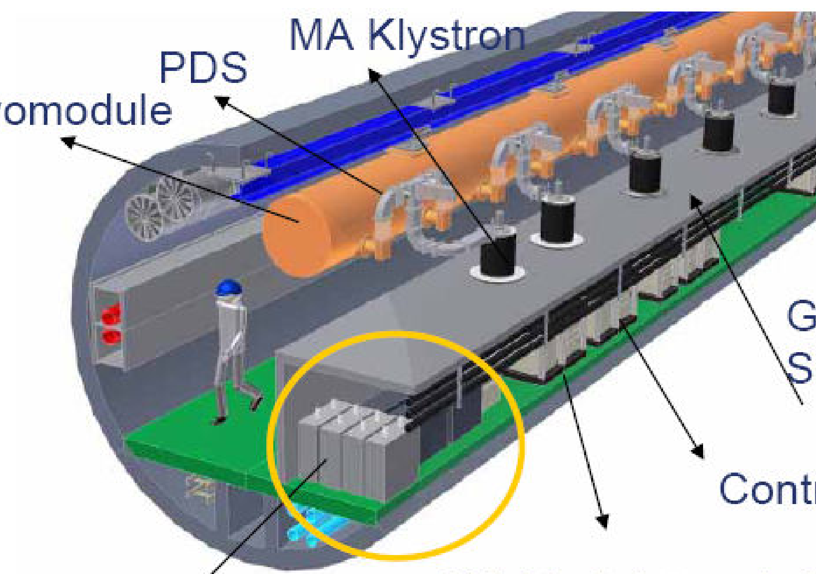
Sketch of 3-Cryo-module unit



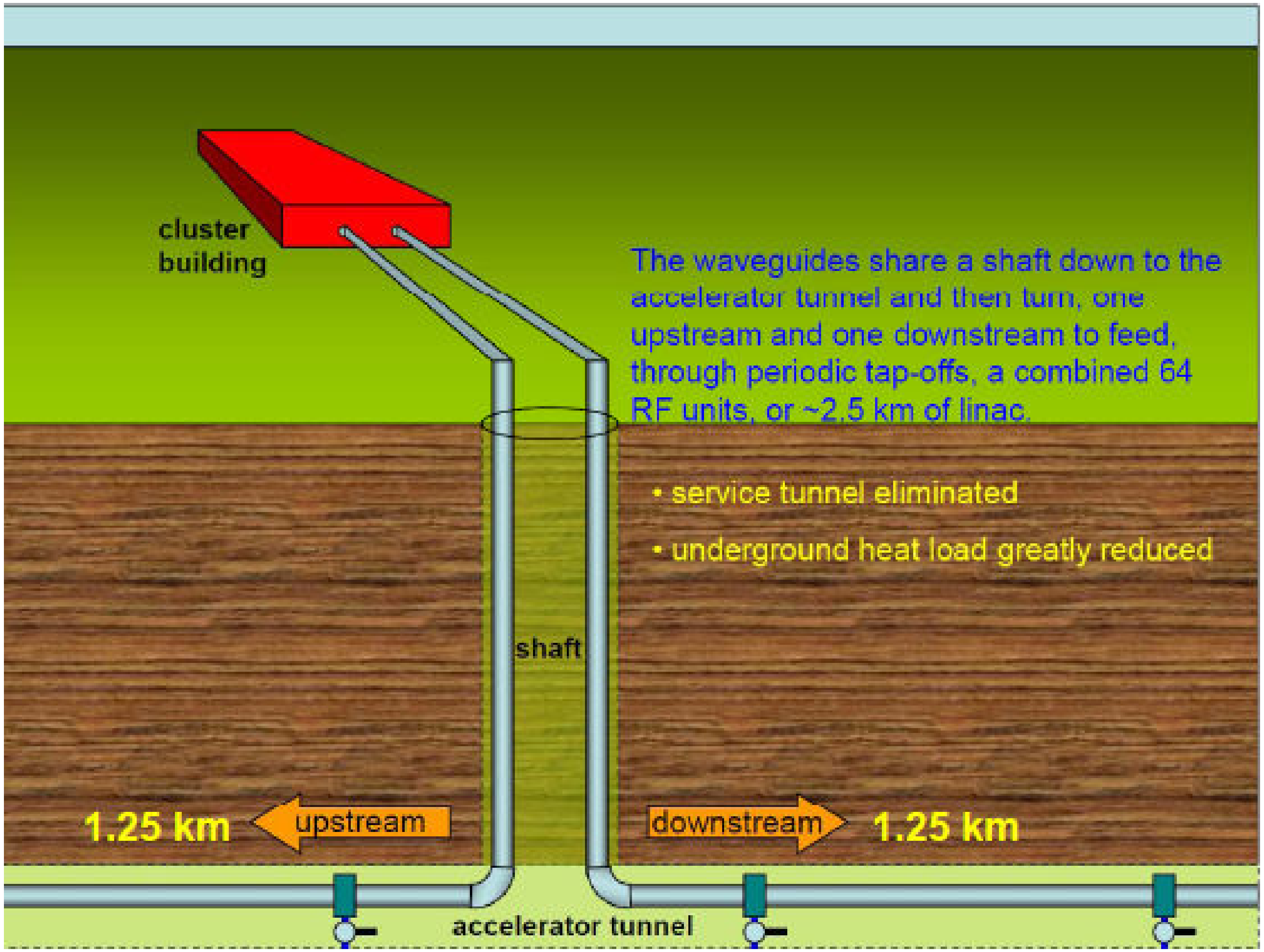
6.6kV In & Rectifier Transformer
Capacitor Bank, Bouncer



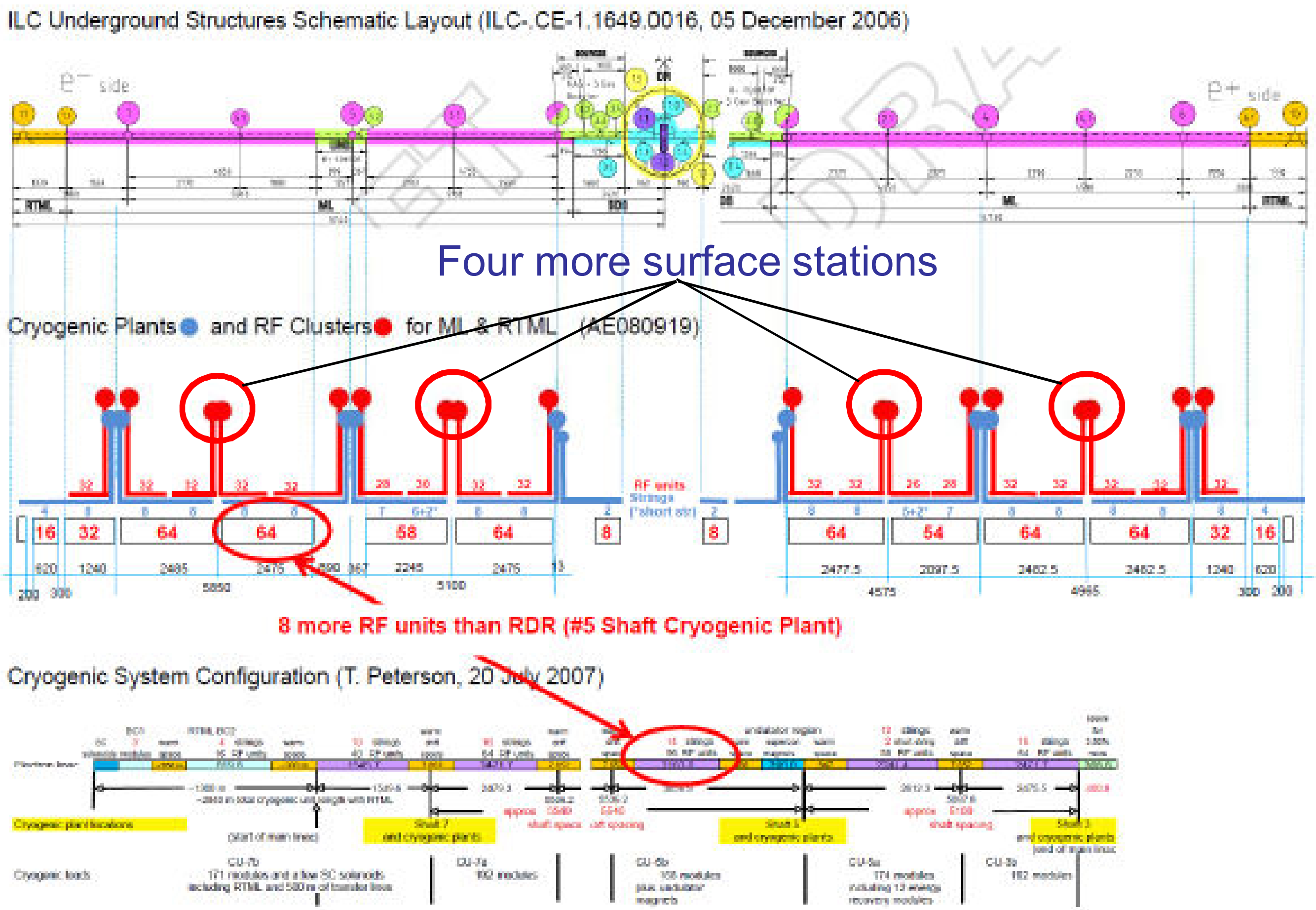
Cross Section



- 5 Reference slides: RF Cluster Scheme,



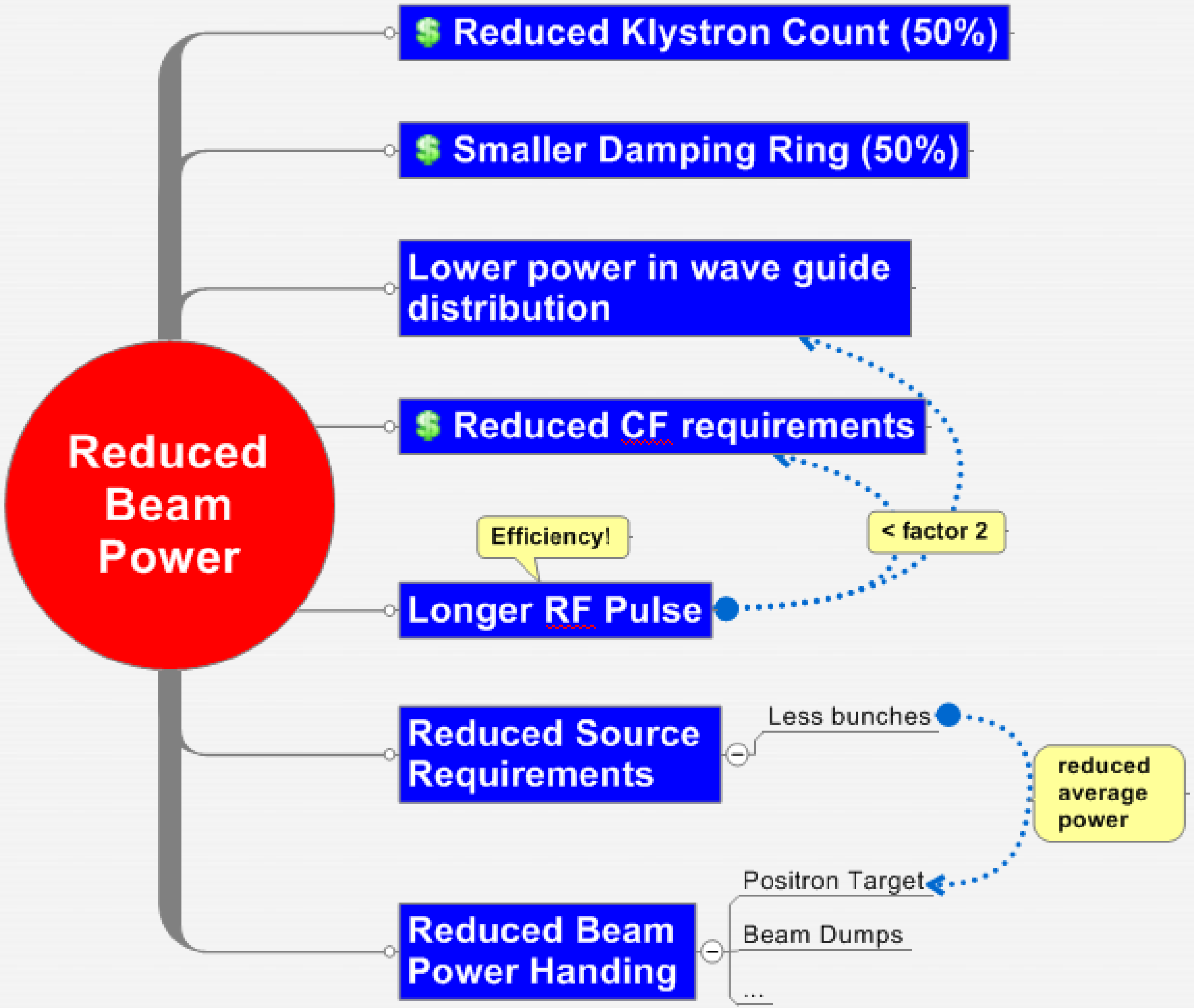
- Schematic layouts of conventional facilities and RF units



US Analysis (C. Adolphsen)

- For the Americas Main Linac tunnels, would save 200-250 M$ with the 7.5 m or 5.2 m single tunnel layouts relative to the baseline.
  - **The TESLA group response to ITRP Question 22 says 350 M Euro would saved for a 1 TeV machine.**
- If increase energy overhead 3% to allow more realistic klystron and modulator MTBFs, cost will be about 180 M$.
- If add shielding or alcoves to allow off-the-shelf electronics, cost will likely be 60-120 M$.
- There will also be additional costs associated with increasing component MTBFs, providing heat and vibration isolation, and installing, commissioning and maintaining the linacs (the increase is both in capital and operating costs).

Reduced Beam Power



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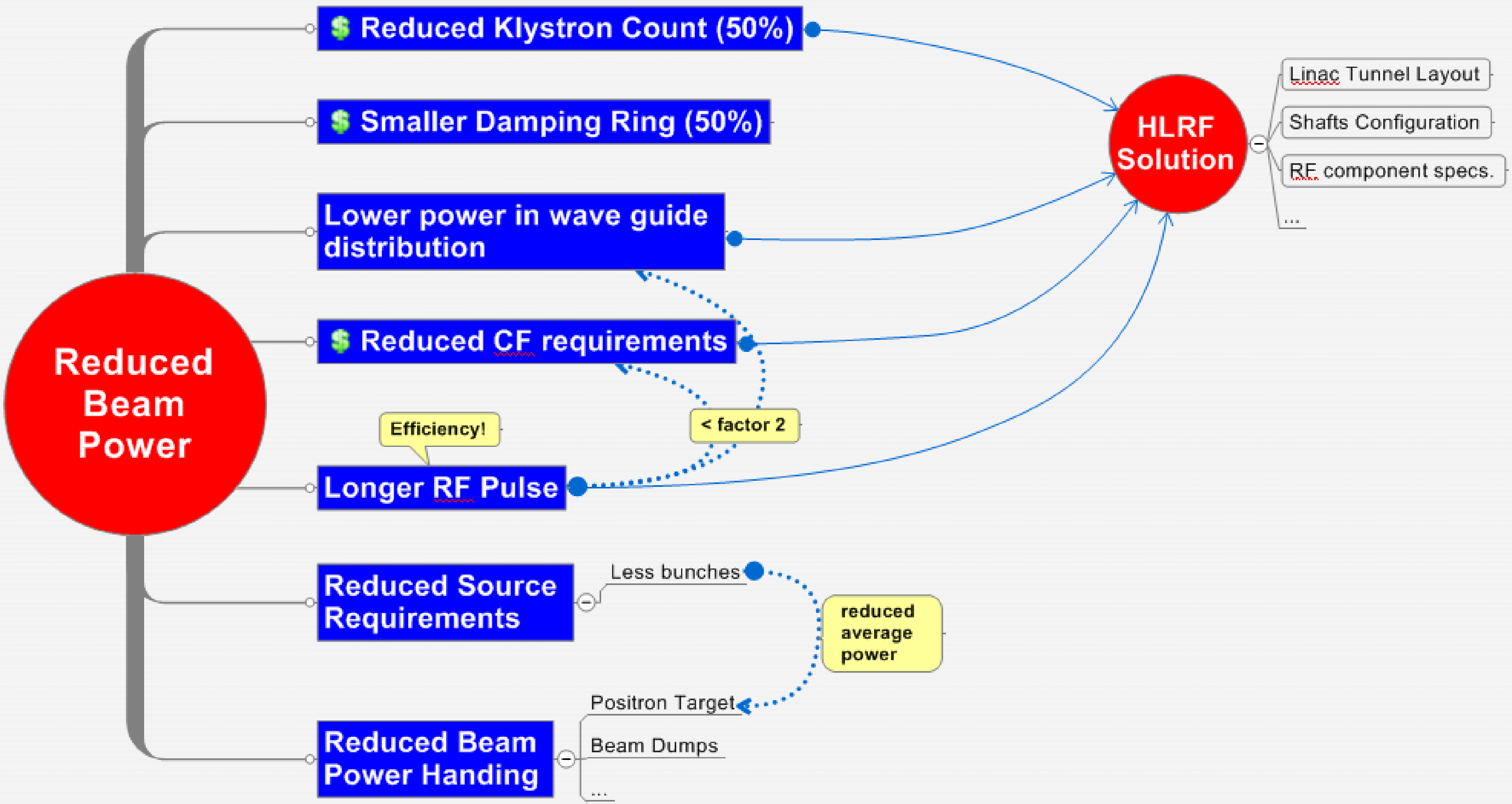

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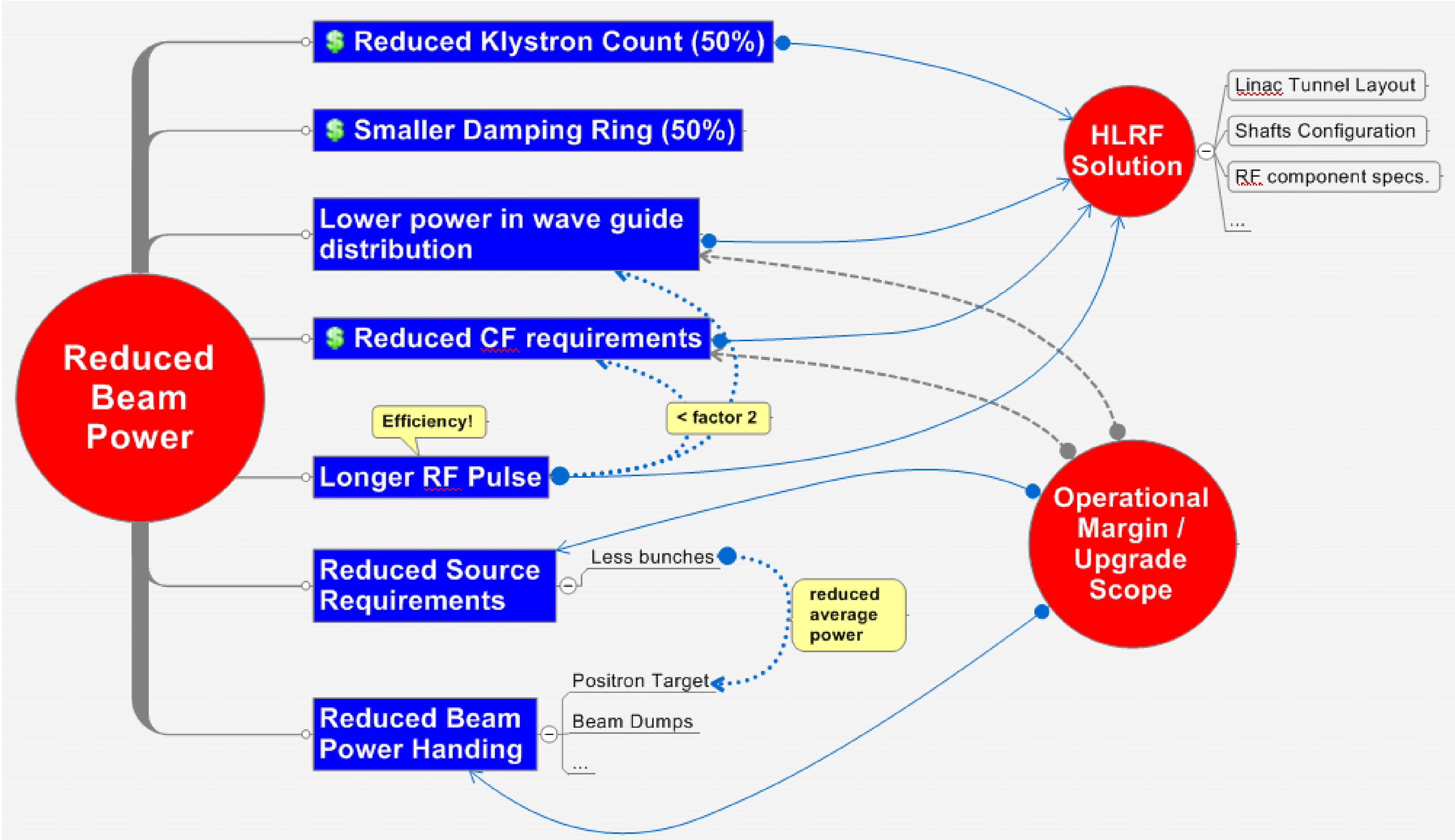
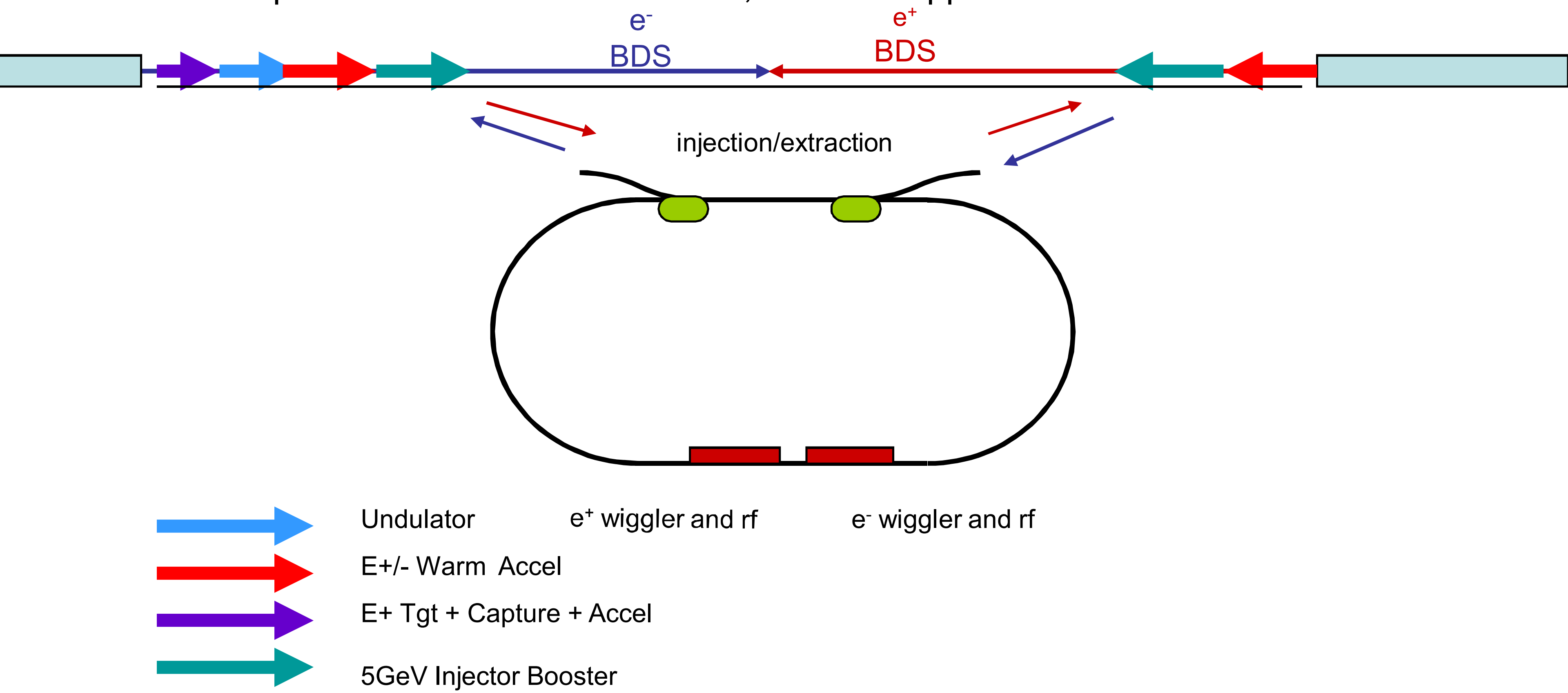


Central Region Integration

- Enough lattices now exist to move forward with “engineering” layout work
- CAD-3D an important part of this exercise
  - **Engineering team well-established**
  - **Central and important role of ILC-EDMS**
  - **Primary tool for evaluating / validating integrated design**
    - Installation issues
    - Shaft locations etc.
    - Cost!
- Primary remaining top-level question remains location for non-beamline components
  - **Need for a service tunnel in CR?**
  - **Initial Working Assumption is YES**

Central Region Case Study 2

5 GeV Boosters share tunnel with BDS
E- Gun and injector share tunnel with BDS
Undulator + Aux Injector + E+ Tgt-Capture-Accel + Booster share tunnel with BDS
No Keep Alive source and two tunnels, beam + support



Positron Source

- Proposed to keep Undulator Source as baseline for SB2009
  - **Most mature 'integrated' system for CFS/CAD3D work.**
- Work on 300Hz stand-alone source (KEK) encouraged
  - **Active R&D programme on 'exotic' targets etc.**
  - **But little or no resources for integrated design work.**
- Primary concerns over potential "single-point" failures of source(s) and lack of (or insufficient) R&D plans to address them:
  - **300Hz system has R&D programme (KEK) on novel issues (liq. Pb and/or hybrid targets etc.), but still need extrapolation to ILC specs.**
  - **Undulator source has remaining risk on rotation target engineering design and 'survivability'.**
  - **Pulsed Flux Concentrator highly desirable but challenging**

Risk Register

- Side note: polarisation was not discussed, but MDI reps made strong comment on the desire for it.

Advanced Conventional e+ Source for ILC

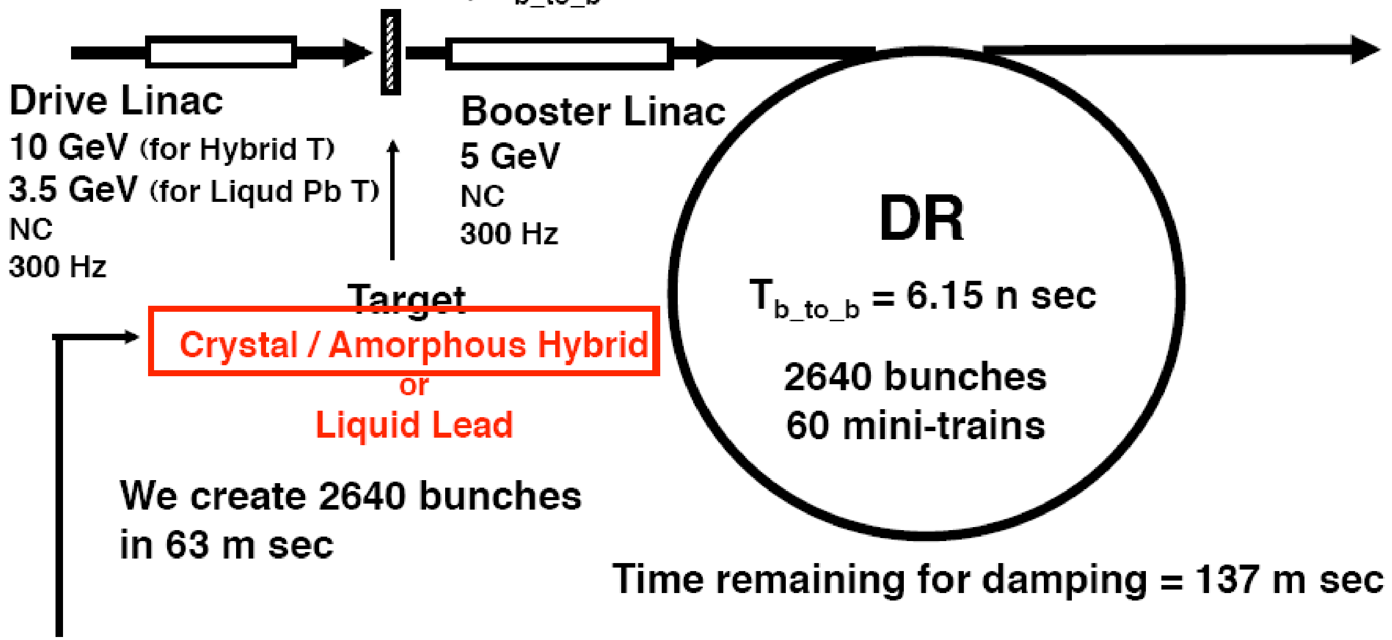
Crystal/Amorphous Hybrid Target or Liquid Lead Target
Normal Conducting Drive and Booster Linacs in 300 Hz operation

e+ creation

20 triplets, rep. = 300 Hz
- triplet = 3 mini-trains with gaps
- 44 bunches/mini-train, $T_{b\_to\_b}$ = 6.15 n sec

go to main linac

2640 bunches/train, rep. = 5 Hz
- $T_{b\_to\_b}$ = 369 n sec



PEDD simulation (Chehab-san)

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Drive Linac
10 GeV (for Hybrid T)
3.5 GeV (for Liqud Pb T)
NC
300 Hz

Booster Linac
5 GeV
NC
300 Hz

DR

$T_{b\_to\_b}$ =

2640
60 mi

Target
Crystal / Amorphous Hybrid
or
Liquid Lead

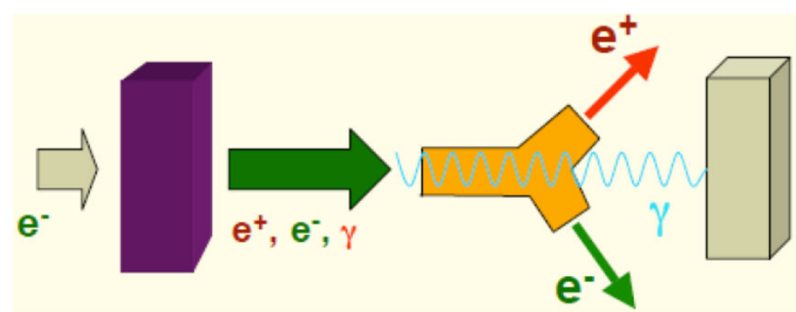
We create 2640 bunches in 63 m sec

Time remainin

PEDD simulation (Chehab-san)

Hybrid Target

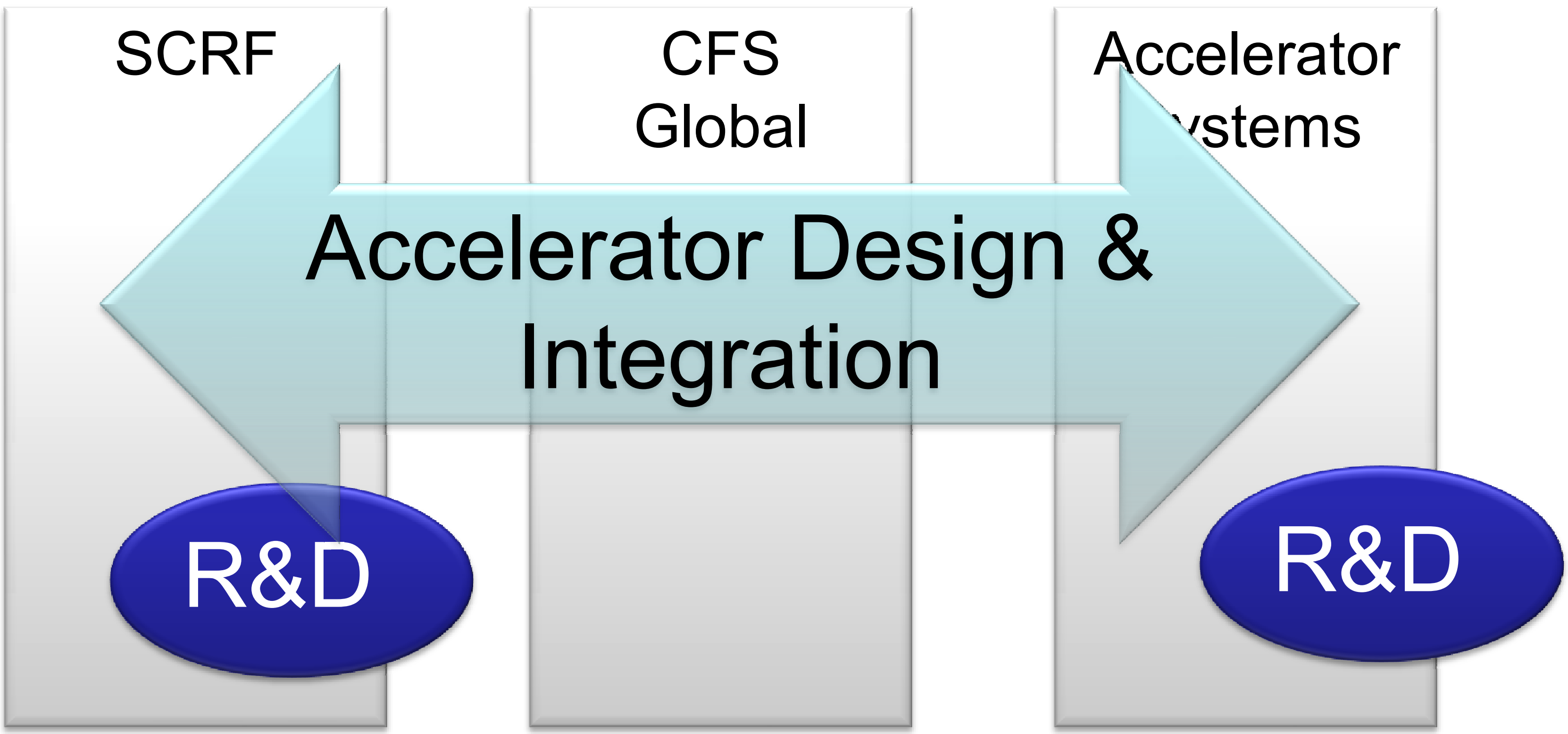
Chehab-san



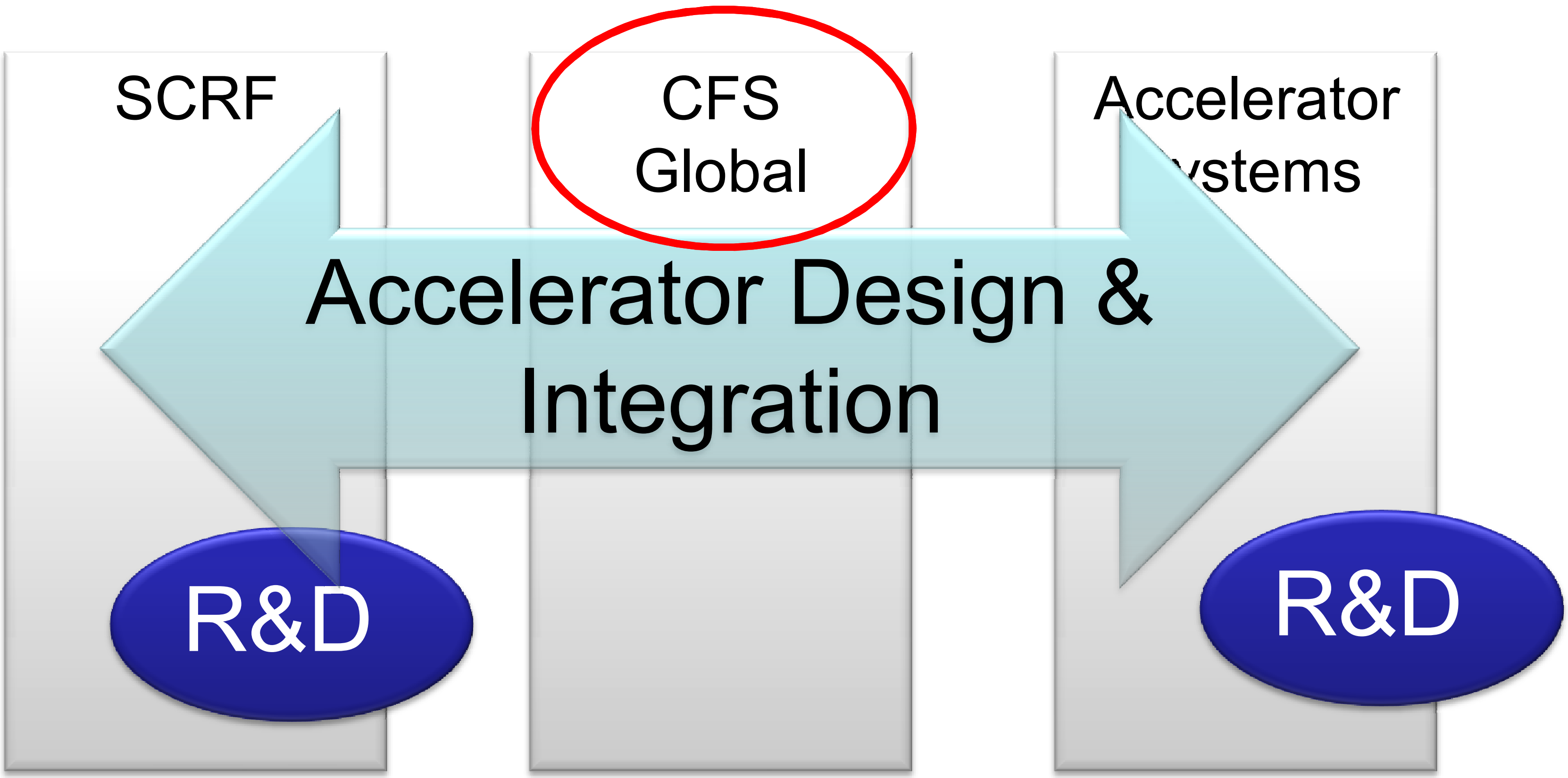
"Radiator"
Thin CRYSTAL

"Converter"
Thick AMORPHOUS

Integrating the AD&I Team



Integrating the AD&I Team



CFS: Primary Cost Driver

- Assumed primary advantage of SB2009 options is reduced CFS scope
  - Underground tunnel / volume
  - Reduced cooling requirements
- Focus of 2009 activities is to assess impact on CFS solution
  - Removed, added, modified
  - Top-level catalogue (WBS-like list)
- Supplying CFS team with required information is primary focus for remainder of 2009
  - Towards baseline proposal
  - Methodology established

Action Items (ALCPG)

- 28 action items identify
  - **Across all systems**
- CFS/HLRF: all three regions to evaluate impact of *both* solutions
- General A.I. is to supply CFS criteria
  - **Changed / modified / added**
  - **Series of WebEx meetings to collate and discuss criteria**
- To do: understand how results of A.I. will feed into discussions at ALCPG
  - **i.e. how we will use the information supplied.**

Other Issues

- Availability
  - **Strong driving arguments for RDR solution(s)**
  - **Fresh look required**
  - **Look at established solutions (LHC, XFEL,…)**
  - **Task force formed – studies being planned**
    - Primary focus: realistic solution for single-tunnel options
- Risk Register
  - **Important tool to understand ‘status’ of R&D**
  - **PM action item to review (How? When?)**
  - **Must include project cost impact**

Timeline

• 28-29 May	DESY meeting
• June/July	CFS requirements review meetings (WebEx)
• 20-21 July	CRI Meeting (SLAC)
• 29.09-03.10	ALCPG (Albuquerque)
• End Nov.	2nd AD&I meeting (TBD)
• Dec.	Proposal Report to EC/AAP
• 4-6.01.10	2nd AAP review

ALCPG (AD&I goals)

- Finalise top-level details of SB2009
  - **Cost increments**
  - **Parameters, sketches, approx. component counts**
  - **Risk register & RDR comparison tables**

- Begin preparation for Proposal Report
  - **Outline**
  - **Content**
  - **Writing assignments**

ALCPG09 GDE Strawman agenda

	Tuesday	Wednesday	Thursday	Friday	Saturday
8.30 – 10.00	Joint Plenary	**GDE Plenary** **Accelerator Design & Integration**	WG's parallel Peter G - sources	WG's parallel Peter G – Main Linac	GDE Plenary WG summaries
10.00 - 10.30	Break	Break	Break	Break	Break
10.30 - 12.00	Joint Plenary	WG's parallel	WG's parallel EC Gov & PIP	WG's parallel EC Gov & PIP	Joint Plenary GDE summary LCWS summary
12.00 - 13.30	EC lunch	EC lunch	EC lunch	EC lunch	
13.30 - 15.00	GDE plenary CLIC, SRF, XFEL etc… Special Det. Session – machine parameters	WG's parallel Peter G – damping ring	WG's parallel Peter G - BDS	WG's parallel Peter G - CFS	
15.30 - 16.00	Break	Break	Break	Break	
16.00 - 17.30	GDE Plenary PM's & TAGL's goals, organisatiion etc …	WG's parallel Panel discussion	WG's parallel	**GDE Plenary** **Accelerator Design & Integration**	

WG's: Sources, BDS, Damping Rings, Main Linac, CFS, Beam Dynamics (?) ….

AD&I Summary

- Major progress on
  - **Defining WA for SB2009**
  - **Re-establishing "Design Team"**
  - **Re-integrating CFS (points-of-contact)**
- Single-tunnel design is primary focus
- Many issues remain to be evaluated
  - **Action items for ALCPG**
  - **Cost increment & risk assessment important**
- Baseline proposal for community discussion in 2010
  - **First 'review' by AAP in January**

ILC-CLIC Developments

ILC-CLIC Developments

- First ever GDE EC meeting hosted by CERN on 11.06.09
  - **At the invitation of the CERN DG**

- Joint GDE – CLIC (ext.) SC meetings on 12.06.09
  - **Discussions of joint WG and common interest themes**
  - **Meeting with senior CERN management**
    - Rolf Heuer (DG)
    - Sergio Bertolucci (Dir. Research & Scientific Computing)
    - *Also* Steinar Stapnes (secr. C.E.R.N. strategy group)

- Agreed on
  - **Continued efforts to work together (common strategy)**
  - **Promote joint WG efforts (and expand where possible)**
  - **Closer management ties:**
    - Delahaye now EC member
    - Foster to join CLIC SC.

- Agreement at end of meeting by Heuer to try and find ILC resources beyond immediate CLIC synergy
  - **Cryogenics**
  - **Cryomodule mass-production**
  - **CFS etc.**

Joint Statement

STATEMENT OF COMMON INTENT

by the CLIC Steering Committee and the ILC Global Design Effort

Recognising the consensus within the particle-physics community on the need for a linear electron-positron collider to explore the physics that will be revealed by the LHC, **considering** the synergies that exist and the opportunities for collaboration that arise between the ILC Global Design Effort and the CLIC study, as well as between the ILC and CLIC physics and detector studies, **building up** on the CLIC/ILC joint statements[1], the two parties

agree that they will define a common strategy to promote and develop scientific and technical preparations for a linear collider, and to exploit wherever possible synergies to enable the design concepts for the ILC and CLIC to be prepared efficiently.

The ILC Global Design Effort Executive Committee and the CLIC Steering Committee will foster this cooperation by agreeing, reviewing and updating a list of topics of common interest. This includes, but is not limited to, the topics listed in Addendum 2 to this agreement, which already form the subjects of joint ILC-CLIC Working Groups.

This Statement of Common Intent is endorsed by the Laboratory and Institute representatives listed and signing in Addendum 1.

Signed ____________________	Signed ____________________
Date ____________________	Date ____________________
(Barry Barish, Director ILC GDE)	(Jean-Pierre Delahaye, CLIC Study Leader)
on behalf of the ILC Global Design Effort Executive Committee	on behalf of the CLIC Steering Committee

- Proposed joint-statement
  - **Originally between machine aspects**
- CERN has proposed to include detectors
  - **CLIC SC already includes detector**
    - Asymmetry
  - **Yamada approach to co-si**

Joint Strategy

- Following slides were proposed and presented to CLIC SC and CERN DG by Americas Regional Director Mike Harrison
- Although not formally endorsed (i.e. signed statements), there was no load protests
- Barish has informed us we are allowed to show both draft statements and Mike’s slides to lab. Management.

ILC-CLIC discussion points

The initial assumptions are:

- it is beneficial to make a single linear collider proposal to the global community and associated science funding agencies,
- this proposal needs to represent a win-win for both the ILC and CLIC communities,
- there is evident synergy between the CLIC and ILC programs.

By general consensus:

- any linear collider proposal will only be approved after the LHC physics results validate the centre-of-mass energy,
- the ILC is more technically mature than CLIC and could submit a proposal by 2012,
- a common cost estimate should be developed.

ILC-CLIC discussion points

- It seems likely that:
  - the incremental cost per Gev of CLIC is less than the ILC in the high energy regime. The drive beam costs ensure that the cost of a low energy collider is less with ILC technology thus there is a cross over point in terms of cost v's energy for the two technologies,
  - Some form of successful string test will be needed to verify the CLIC technology,
  - LHC physics results are available on the 2012 time scale.

ILC-CLIC discussion points

Thus possible scenarios might look like:

1. The LHC indicates that ~ 500 Gev is sufficient for a compelling physics program. An ILC-like project is submitted for approval in 2012 as a first phase of a complete linear collider program. The ILC-CLIC collaboration continues to work together through the design, construction and operation phases of this facility with a common goal of a long range upgrade which reaches into the TeV energy range and re-uses as many of the ILC facilities and systems as is possible.

2. The LHC indicates that > 1Tev is necessary. R&D on the CLIC continues but on a faster pace with the addition of ILC resources. The CLIC R&D program expands to include the other machine elements in more detail and possibly a two-beam sector test.

ILC-CLIC discussion points

3. The LHC indicates that the appropriate energy lies in the range of 500 Gev -> 1 Tev. The cost X-over point has been determined by the CLIC CDR and thus is available to help in the decision as to whether propose 1) or 2) with the appropriate CoM energy.

4. In view of the many uncertainties then a steady-as-we-go continuation of the current collaborative interaction is appropriate until a later date. Occasional meetings between the CERN Directorate and the GDE EC would continue as part of this collaboration.