GDE Report

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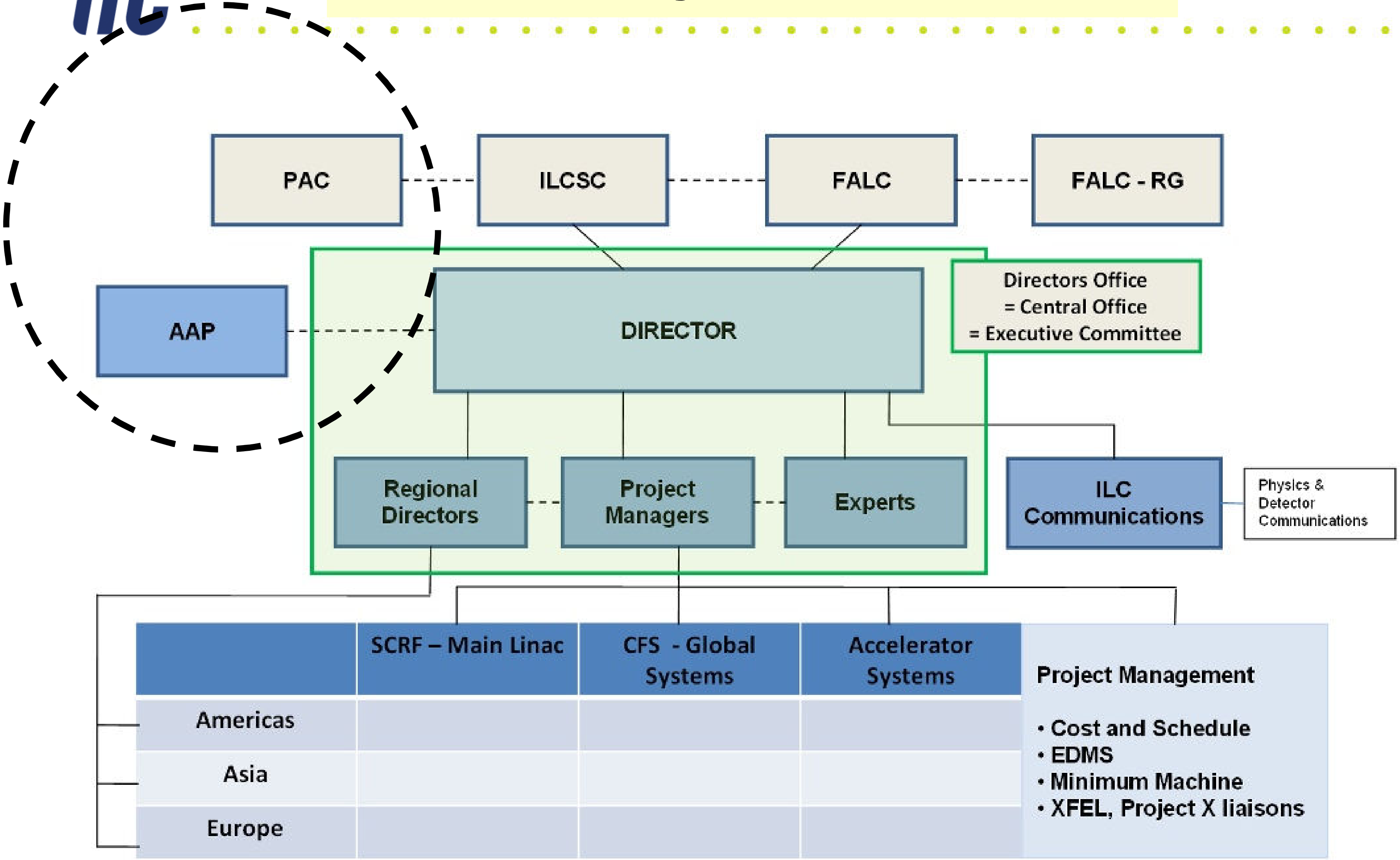
ALCPG – Albuquerque
29-Sept-09

Progress since TILC09 - April 09

- AAP Review at TILC09 (highlights)
- PAC Review – May 09 (highlights)
- New R&D Plan – ver 4
- SCRF Progress (gradient; S1 tests at FLASH)
- CLIC / ILC Collaboration
- ILC Implementation: Industrialization & Governance Studies

- New Baseline (AD&I) – N Walker 4:45pm today
- Public Lecture – "The Mysterious Universe" J Brau – Thursday night at 7:30pm

GDE Project Structure



Technical Reviews

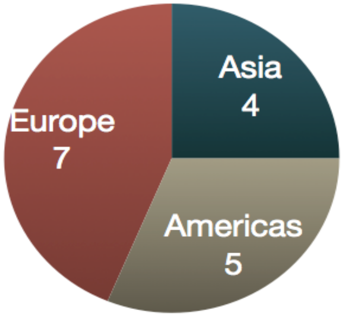
- Accelerator Advisory Panel (Willis & Elsen)
  - **On-going reviews by assigned AAP members to particular systems (attend meetings, etc) Example result: Questions regarding plug compatibility have resulted in studies, report**
  - **Technical Review – first one 3.5 days at TILC09 in April. Internal + 4-5 external reviewers. Yearly through TDP phase with continuity. First review: Overall coverage + focus areas**
- ILCSC PAC Review:
  - **1.5 days (1 day GDE); higher level review and will use AAP review as input.**

AAP Review

- **The Accelerator Advisory Panel review addressed the superconducting RF program, conventional facilities, electron cloud R&D, test facilities operation and project management.**

AAP Reviewers

- Regular Members
  - C Damerell
  - J Dorfan
  - E Elsen
  - T Himel
  - M Kuriki
  - O Napoly (*)
  - K Oide
  - H Padamsee
  - T Raubenheimer
  - D Schulte
  - W Willis



- External Members
  - N Holtkamp (*)
  - L Rossi (*)
  - T Tajima
  - M Uesaka
  - F Zimmermann

(*) apologies received

- F Lehner served as the scientific secretary for this meeting

AAP Review - highlights

- Understanding e-cloud

The AAP notes that once the current rounds of measurements are completed and the modeling software has been updated to incorporate what has been learned from the measurements, the impact of the e-cloud must be reevaluated for the 12 ns and 6 ns bunch spacings in the damping ring designs. This will provide an updated assessment of the risk to damping ring performance from the effects of the e-cloud. Should the risk factor be too high, the AAP observes that a lower-current ILC machine with half the number of bunches in the 6-km configuration, i.e. 12 ns bunch spacing would operate in a safer regime with regard to electron cloud. Reducing the positron ring circumference to 3-km may risk losing this back-up solution.

The AAP would like to see a plan laid out showing how the damping ring group plans to arrive at a decision for the viability of the ILC damping ring choice with respect to electron-cloud immunity. A clear set of criteria for the vacuum system should be developed that will lead to the choice of a baseline solution. Alternates along with required R&D can also be specified. A schedule for establishing the criteria and the baseline should be shown.

Project Planning cont'd & Conclusion

- Preparation for 2012
  - some technical goals will have to be pursued beyond the timeline
    - gradient development and string test
  - LHC will be running
    - time is ripe for a decision
    - Have to prepare pro-actively
      - plan for success
      - develop a long-term strategy

The AAP suggests asking ILCSC to consider displaying and arbitrating the use of laboratory resources more formally. Proper orchestration of the in-kind contributions is mandatory to advance the likelihood of implementation of the ILC. Sudden changes in commitment should be avoided and, if necessary, should be communicated in the ILCSC.

Laboratory Commitments to ILC R&D

- The system with work packages and associated laboratory based MOU's became obsolete during the 2008 funding interruption in the UK & US.
- This system has been replaced by an ad-hoc series of bilateral agreements with the GDE and the national labs for work scope or facility access e.g. FP7 projects such as Hi-Grade in the EU, ATF2 at KEK, ART program in the US, which are embedded in a variety of management structures. A common R&D program has also been established with Project X at Fermilab.
- This has given rise to situations where internal lab priorities have had the result of moving critical personnel away from the GDE program.
- Both the AAP and the PAC flagged this issue and suggested it be discussed at ILCSC, which contains several lab directors.

AAP Review

- The full report is available through GDE website
- The next AAP review will take place in Oxford, UK in January 2010
- The focus of this review will be the new machine baseline.

PAC Review – May 09, Vancouver

- **“Satisfactory progress is being made towards a Technical Design Report in 2012. At some time in the future, ILCSC guidance will be needed for activities beyond that date.”**
- **“The PAC supports the GDE Director’s AAP process, and endorses the conclusions of the AAP’s recent review. It looks forward to seeing the response to the AAP’s recommendations.”**
- **“There is some concern by the PAC on whether there will be enough cavities available to obtain meaningful statistics on the yield, and more information on the needed statistics would be helpful. Some help on this may be forthcoming from the XFEL, Project X and Quantum Beam projects.”**

PAC Review – May 09, Vancouver (continued)

Renamed
"Accelerator Design and Integration" (AD&I)

- **"The PAC supports the "Minimum Machine" activities to carefully review the RDR design ……… The Committee believes that this activity should not compromise the existing ILC physics goals, and reiterates its belief that the 1 TeV upgrade option should be maintained."**

The next review is scheduled for Nov 2,3 in Pohang, Korea.

Updated ILC R&D / Design Plan

ILC Research and Development Plan for the Technical Design Phase

Release 4

July 2009

ILC Global Design Effort

Director: Barry Barish

Prepared by the Technical Design Phase Project Management

Project Managers: Marc Ross, Nick Walker, Akira Yamamoto

Major TDP Goals:

- **ILC design evolved for cost / performance optimization**
- **Complete crucial demonstration and risk-mitigating R&D**
- **Updated VALUE estimate and schedule**
- **Project Implementation Plan**

R & D Plan Resource Table

- Resource total: 2009-2012

FTE	SCRF	CFS & Global	AS	Total
Americas	243	28	121	392
Asia	82	9	51	142
Europe	108	17	64	189
	433	55	236	724

MS (K$)	SCRF	CFS & Global	AS	Total
Americas	18080	2993	6053	27126
Asia	23260	171	5260	28691
Europe	9890	921	530	11341
Total	51231	4085	11843	67158

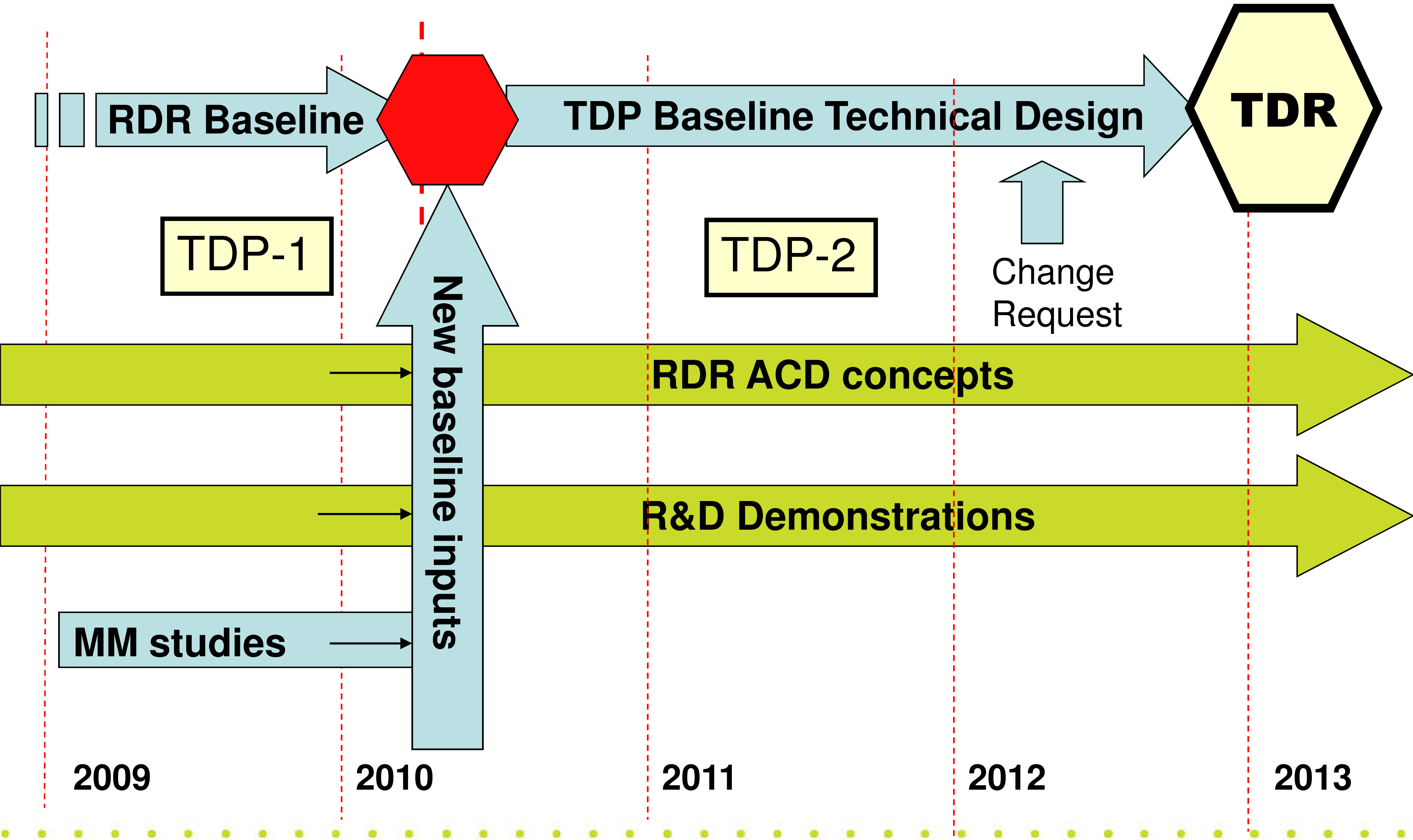
- Not directly included:
  - **There are other Project-specific and general infrastructure resources that overlap with ILC TDP**

2009 – 2012: Resource Outlook

- Flat year-to-year resource basis
  - **Focused on technical enabling R & D**
  - **Limited flexibility to manage needed ILC design and engineering development**

- Well matched between ILC technical and institutional priorities with some exceptions:
  - **Positron system beam demonstrations**
  - **CF & S criteria optimization and site development**

Technical Design Phase <u>and Beyond</u>



ILC R&D Beyond 2012 ?

- The AAP points to uncertainties beyond 2012 in their conclusions:
  - **"Some aspects of the R&D for the ILC will have to continue beyond 2012."**
  - **"The milestone 2012 is however timely placed. The LHC will be providing operating experience of a large facility and with some luck the first physics discoveries will emerge."**
  - **"The HEP community is thus well prepared for the decision for the next facility. In a sense the construction of the ILC seems the natural evolution of that process, in which case the efforts for the ILC have to be ramped up without delay."**
  - **"Nature may be less kind or science policy makers not ready for a decision on the next big HEP project. In this case the large community must be engaged to facilitate the decision for the construction of the next HEP project."**
- We need to prepare for uncertainties in the path to the ILC after 2012, including what LHC tells us.

Major R&D Goals for TDP 1

SCRF

- **High Gradient R&D - globally coordinated program to demonstrate gradient by 2010 with 50%yield**
- **Preview of new results from FLASH**

TODAY

ATF-2 at KEK

- **Demonstrate Fast Kicker performance and Final Focus Design**

Electron Cloud Mitigation – (CesrTA)

- **Electron Cloud tests at Cornell to establish mitigation and verify one damping ring is sufficient.**

Accelerator Design and Integration (AD&I)

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

The ILC SCRF Cavity

Figure 1.2-1: A TESLA nine-cell 1.3 GHz superconducting niobium cavity.

- Achieve high gradient (35MV/m); develop multiple vendors; make cost effective, etc

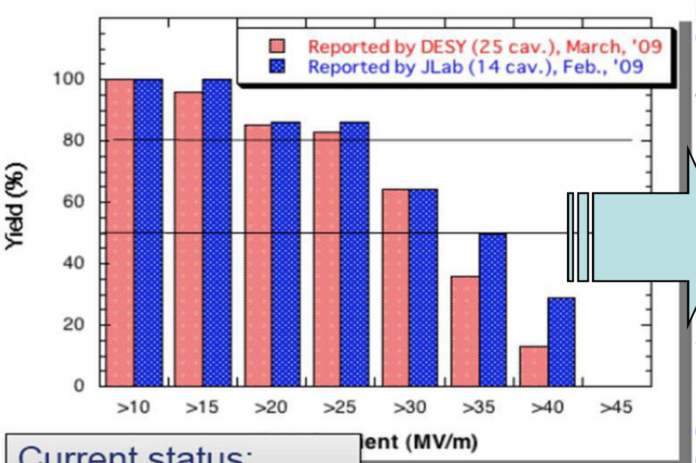
- Focus is on high gradient; production yields; cryogenic losses; radiation; system performance

Yield Plot

- The gradients for DESY data were off by +2MV/m
- Not 08/09: large component of 2007, and very small component of 2009
- Not 1st or 2nd test: instead, last (DESY) or best (JLab)
- Included cavities fabricated by ACCEL, ZANON, AES, JLab-2, KEK-Ichiro

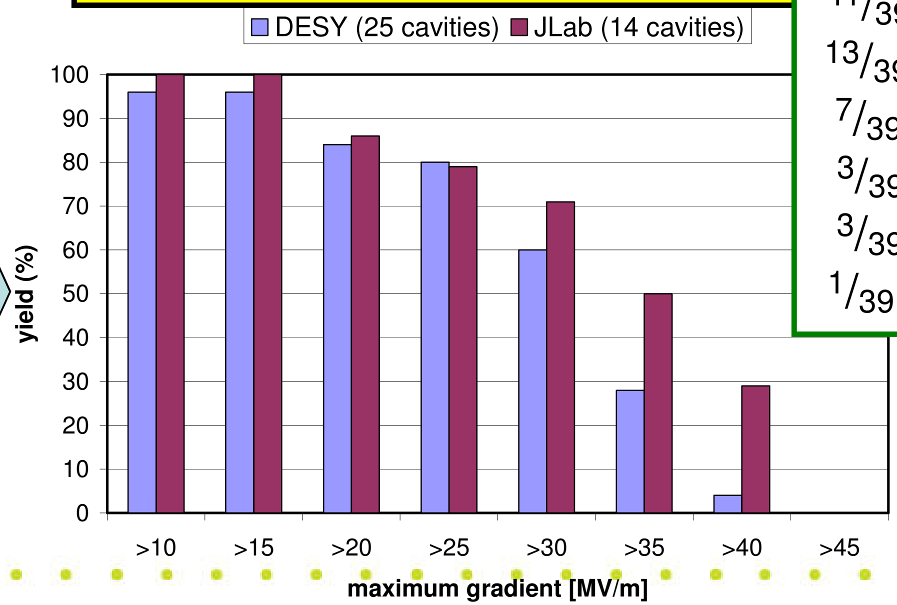
This is not the ideal data selection from which to infer a production yield

Old version,
shown at PAC, 2009



Current status:
50% yield at ~ 33 MV/m;
(80% >25MV/m)

Revised version (corrected only for mistakes)
- same data shown



11/39 1st test
13/39 2nd test
7/39 3rd test
3/39 4th test
3/39 5th test
1/39 8th test

Definition of 'Yield'

- Original S0 concept assumed:
  - **Surface can be reset according to the EP process, and**
  - **Multiple processes may be integrated for statistics.**
- Several years of experience shows
  - **Repeat processing may cause degradation**
- Processing and Test recipe has been updated
  - **Complete the process and test only with the first cycle**
    - no further processing if the results are acceptable
- Revision of the definition of 'yield' is required
  - **Process (R&D) and Production definitions are different**
  - **A common means for collection and evaluation of the data is required**

Creation of a Global Database

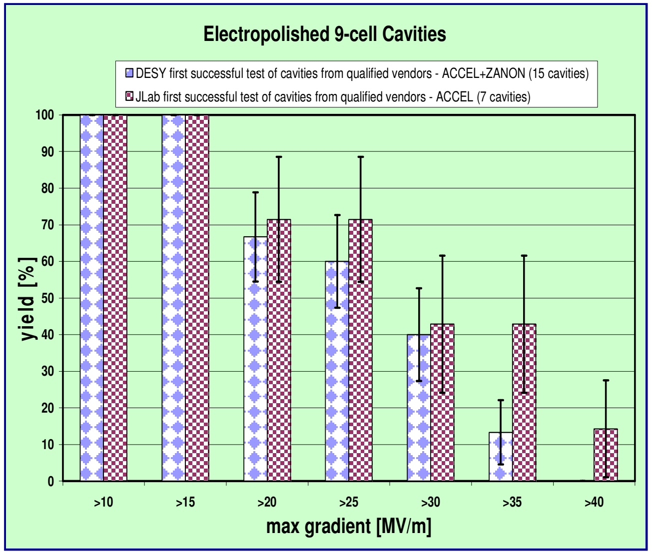
- Global Data Base Team formed, May 2009:
  - **Camille Ginsburg (Fermilab) – Team Leader & Data Coordination**
  - **Zack Conway (Cornell University)**
  - **Sebastian Aderhold (DESY)**
  - **Yasuchika Yamamoto (KEK)**
  - **Rongli Geng (JLab) – GDE-SCRF Cavity TA Group Leader**

Standard Process for Yield Plot

	Standard Cavity Recipe
Fabrication	Nb-sheet (Fine Grain)
	Component preparation
	Cavity assembly w/ EBW (w/ experienced venders)
Process	1st Electro-polishing (~150um)
	Ultrasonic degreasing with detergent, or ethanol rinse
	High-pressure pure-water rinsing
	Hydrogen degassing at > 600 C
	Field flatness tuning
	2nd Electro-polishing (~20um)
	Ultrasonic degreasing or ethanol
	High-pressure pure-water rinsing
	Antenna Assembly
	Baking at 120 C
Cold Test (vert. test)	Performance Test with temperature and mode measurement (1st / 2nd successful RF Test)

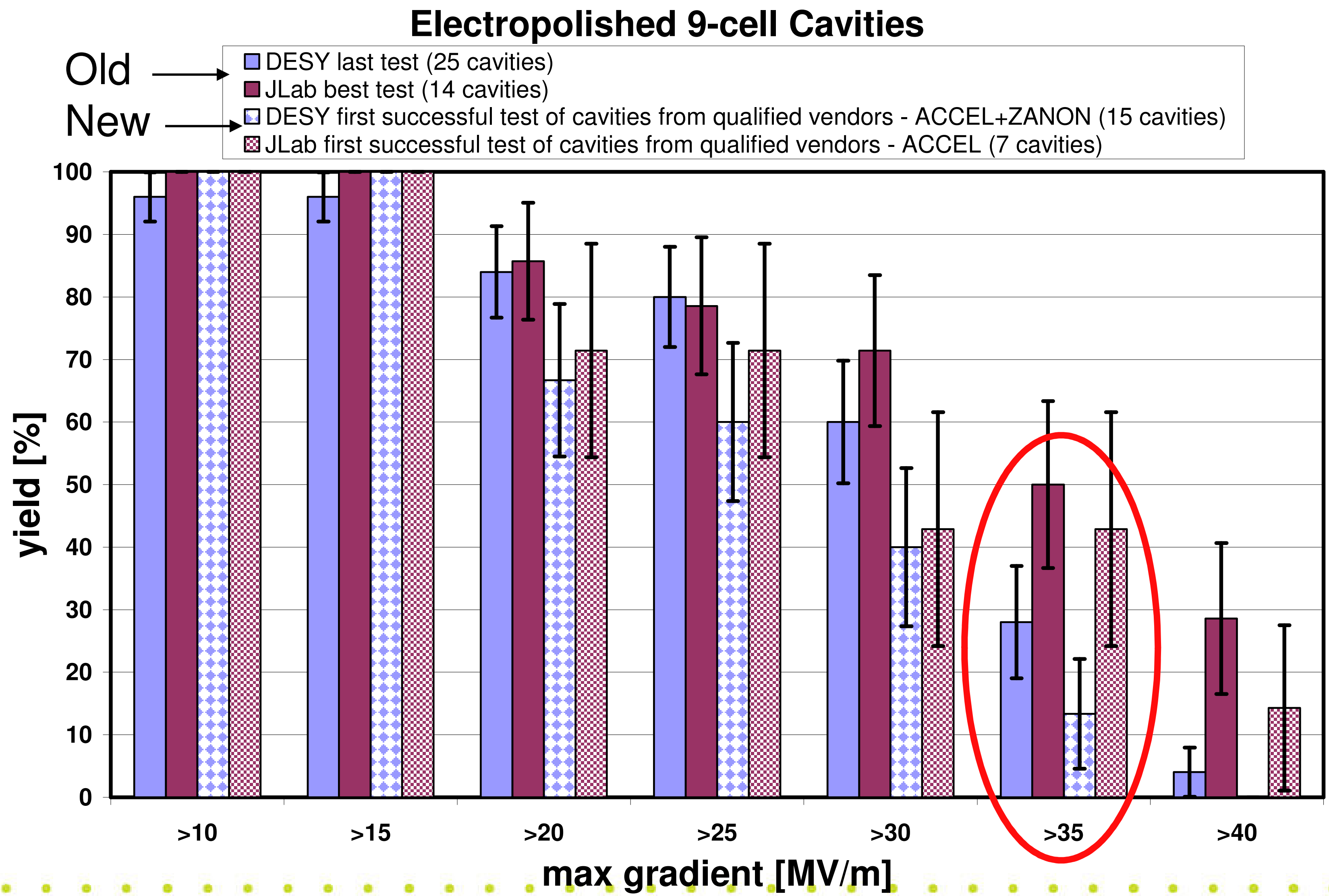
Example New Yield Plot

- Vertical axis: fraction of cavities satisfying criteria where:
  - Denominator (logical and of the following):
    - **Fabricated by <u>ACCEL or ZANON</u>**
    - **Delivered to labs within last 2-3 years**
    - **<u>Electro-polished</u>**
    - **Fine-grain material**
  - Numerator (logical and of the following):
    - **Denominator**
    - **Accepted by the lab after incoming inspection**
    - **1st successful vertical RF test,**
      - **excluding any test with system failure, has max gradient > (horizontal axis bin) MV/m;**
      - **ignore Q-disease and field emission (to be implemented in future)**
- Horizontal axis: max gradient MV/m
- Exclude cavities which are work-in-progress, i.e., before rejection or 1st successful RF test



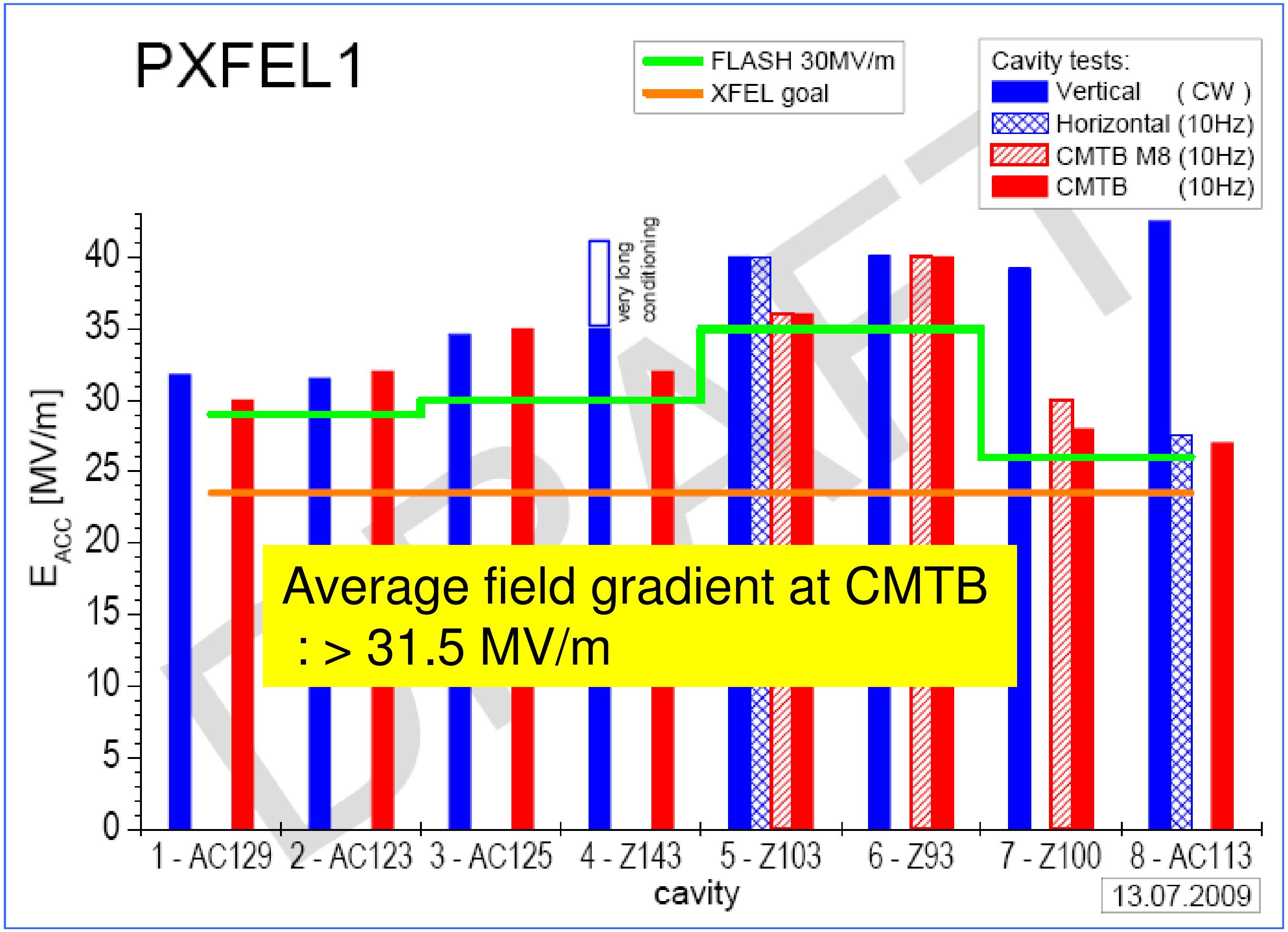
Note: These are results from the vertical CW test at DESY and JLab

Comparison 'Old' vs 'New' Yield Plo



S1 Goal: Reached at DESY PXFEL1

reported by H. Weise, at SRF-09

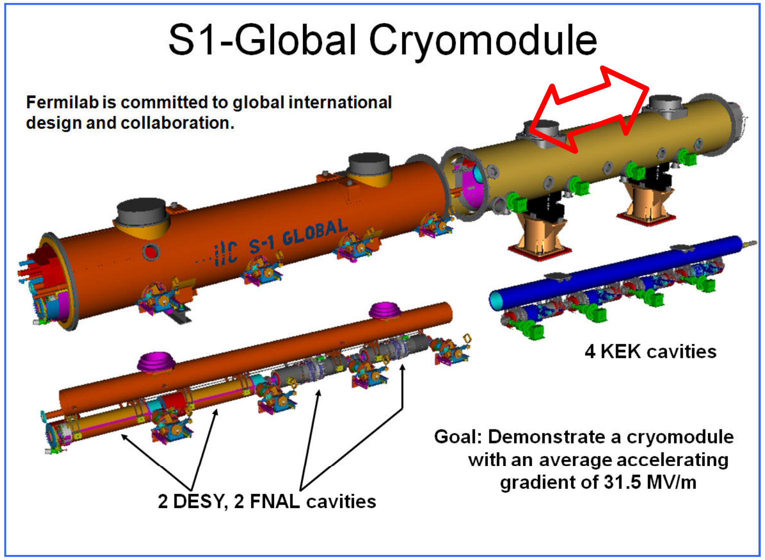


Note: DESY prepared cavities and assembled with the cryomodule cold mass contributed by IHEP for XFEL prototype

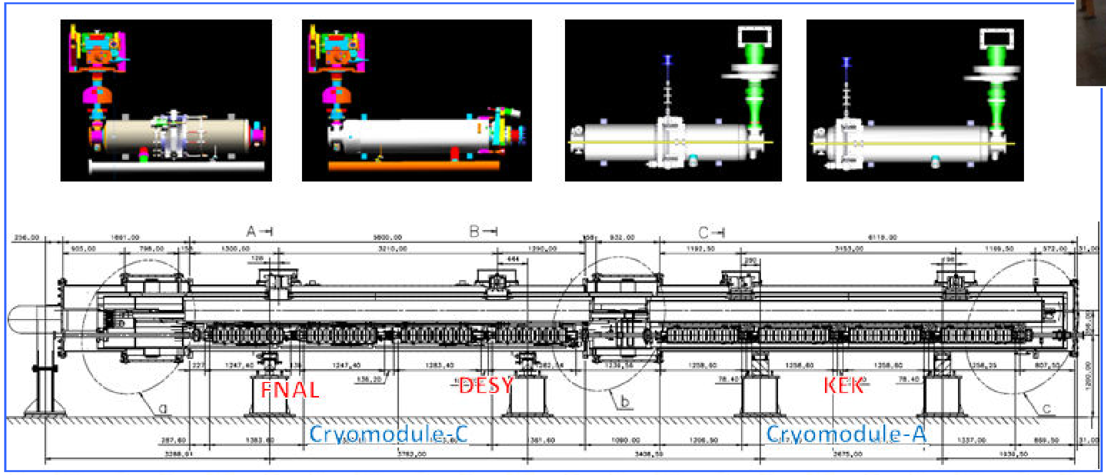
Global Plan for SCRF R&D

Year	07	2008	2009	2010	2011	2012
Phase	TDP-1			TDP-2		
Cavity Gradient in v. test to reach 35 MV/m	>> Yield 50%			>> Yield 90%		
Cavity-string to reach 31.5 MV/m, with one-cryomodule		**Global effort** for plug-compatible string (DESY, FNAL, INFN, KEK)				
System Test with beam acceleration		FLASH (DESY)			NML (FNAL) STF2 (KEK)	
Preparation for Industrialization			Mass Production Technology R&D			

S1-Global Cryomoduleto be delivered from INFN/ZANON to KEK, Nov. 2009

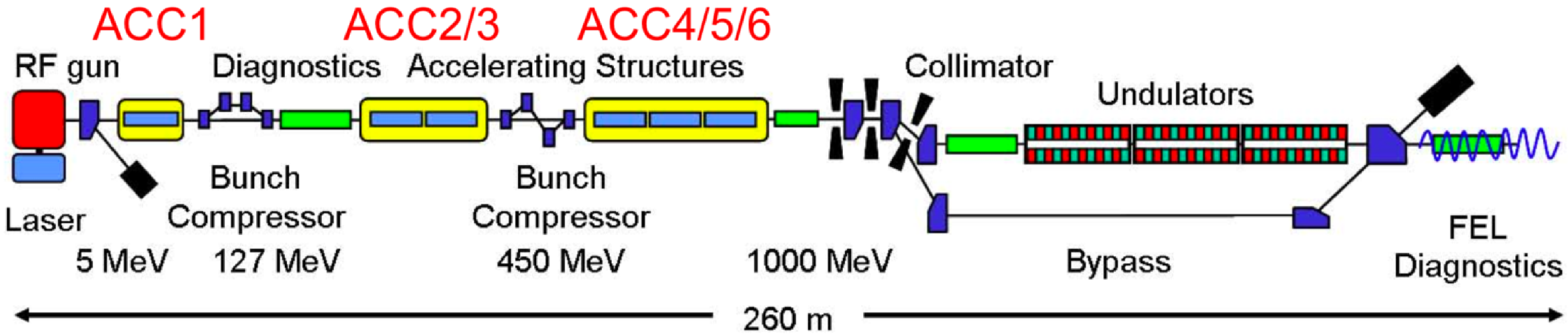


Diagnostics installation
In July 2009



TTF/FLASH 9mA Experiment

Full beam-loading long pulse operation → "S2"



		XFEL	ILC	FLASH design	9mA studies
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

- Stable 800 bunches, 3 nC at 1MHz (800 μs pulse) for over 15 hours (uninterrupted)
- Several hours ~1600 bunches, ~2.5 nC at 3MHz (530 μs pulse)
- >2200 bunches @ 3nC (3MHz) for short periods

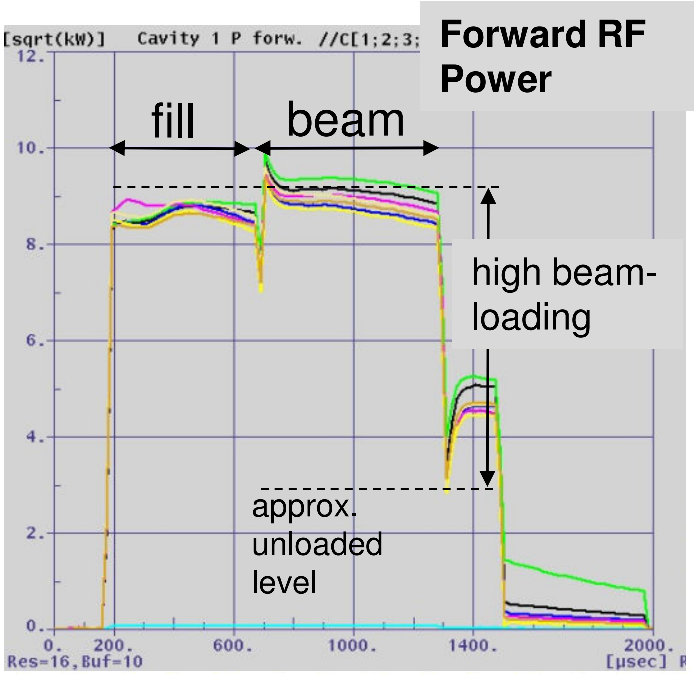
9mA Experiment Status

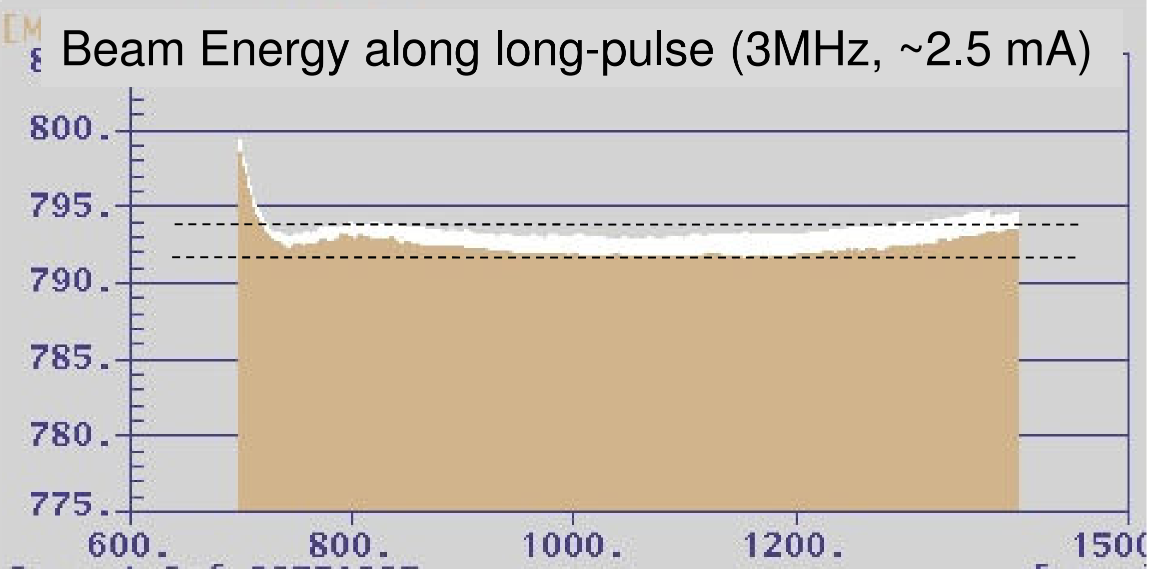
- Successfully completed 2-week dedicated experiment
  - **Total 5-week interruption to FLASH photon user programme when shutdown for dump-repair is included (thanks to DESY)**
- Commissioning of new hardware
  - **3MHz laser**
  - **Simcon-DSP LLRF system(s)**
  - **New instrumentation in dump line**
- Detailed data analysis now just beginning
  - **Will take some months of analysis**
- Stable operation with high beam-loading (high beam-powers) demonstrated, but
  - **Not all (original) 9mA goals were achieved**
  - **Routine operation of long bunch trains still requires work**
  - **Planning for next shifts (proposal) now underway**

9mA Example Results

Much experience gained running with high beam-loading conditions

Approx. 15 TBytes of data to be analysed (on-going)



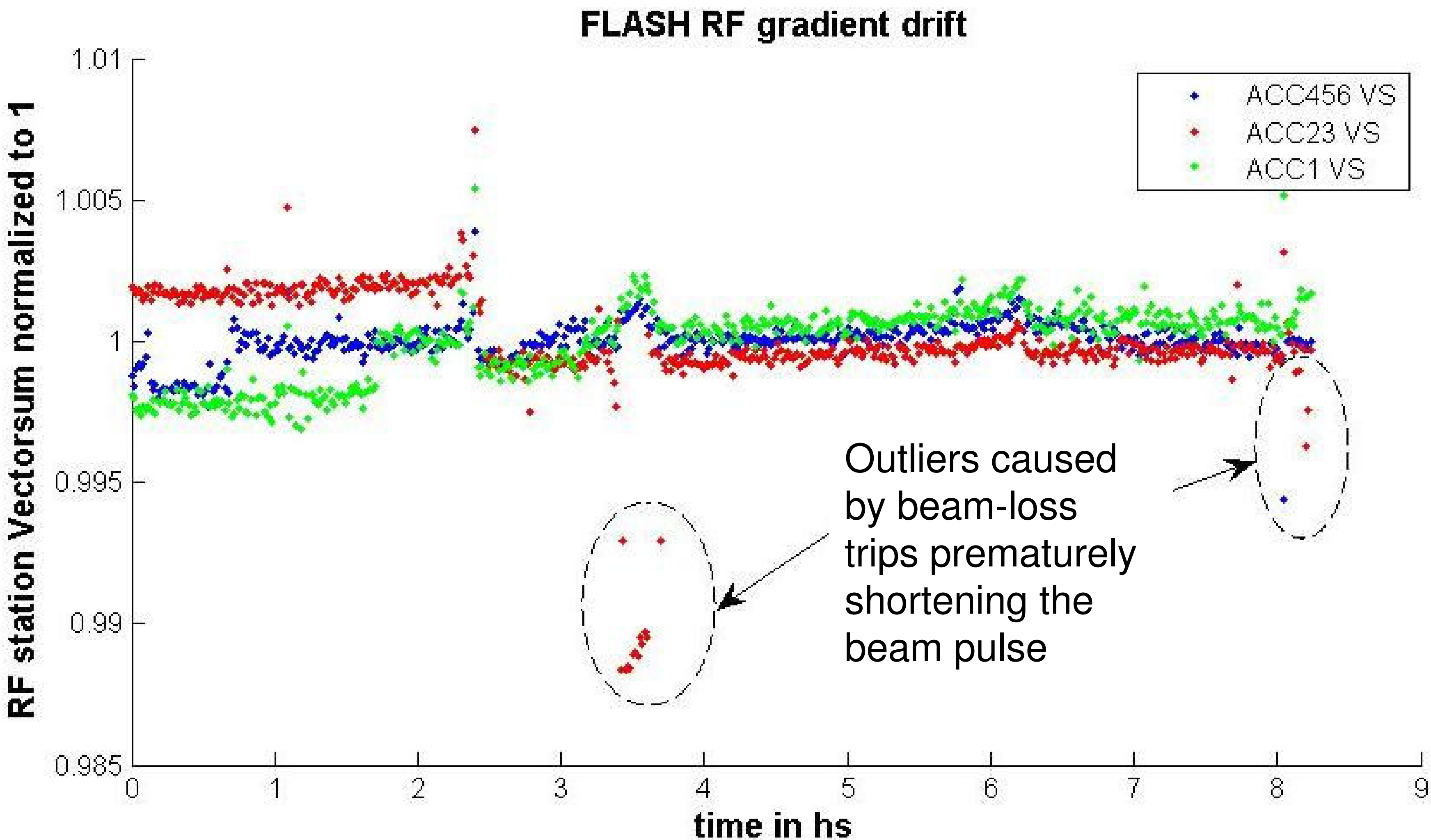


Along pulse: 0.1% RMS (0.5% pk-to-pk)
(after initial transient)
Pulse-to-pulse (5Hz): 0.13% RMS

Integrated Systems Test
- Understanding trip and trip recovery (beam loss)
- RF parameter tuning
- RF system calibration

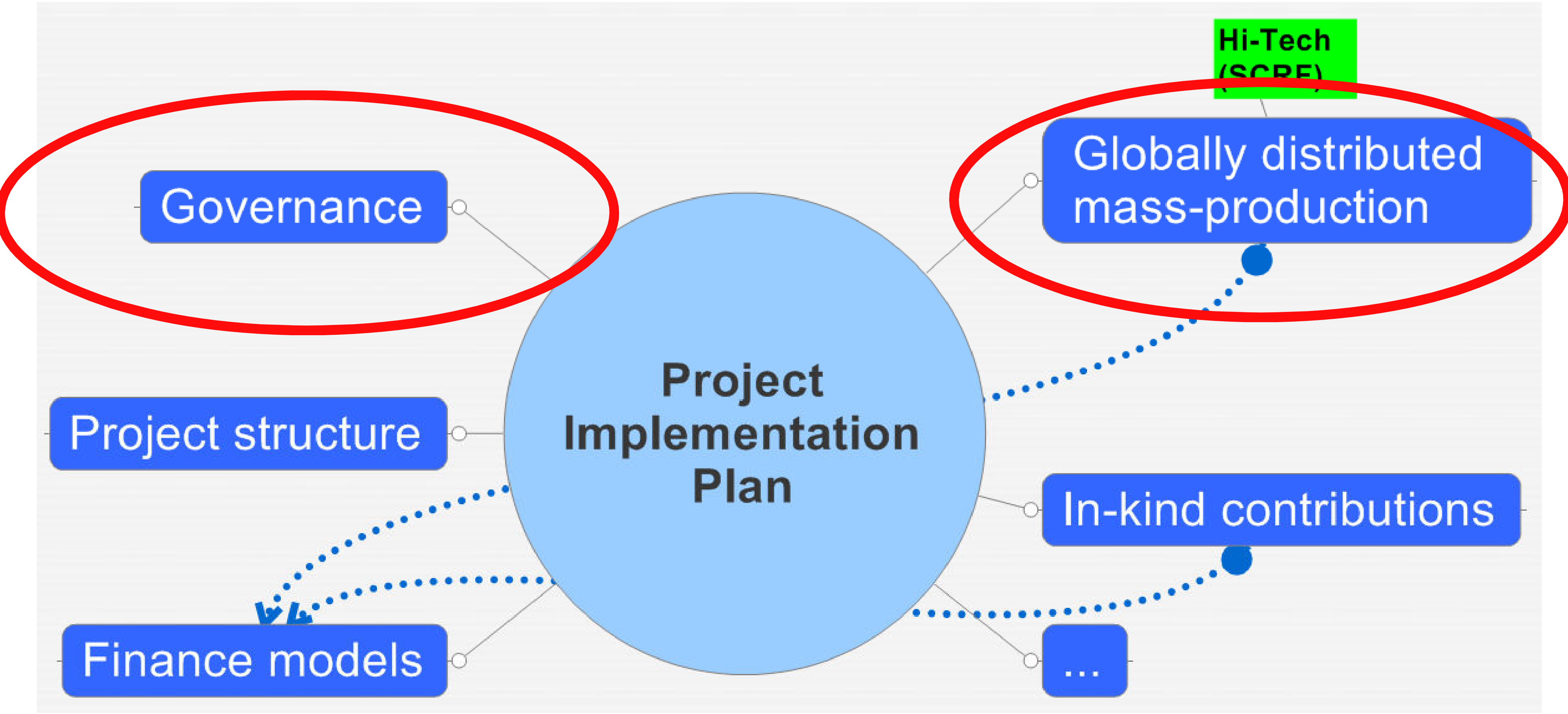
Extrapolation to XFEL/ILC

RF Gradient Long-Term Stability

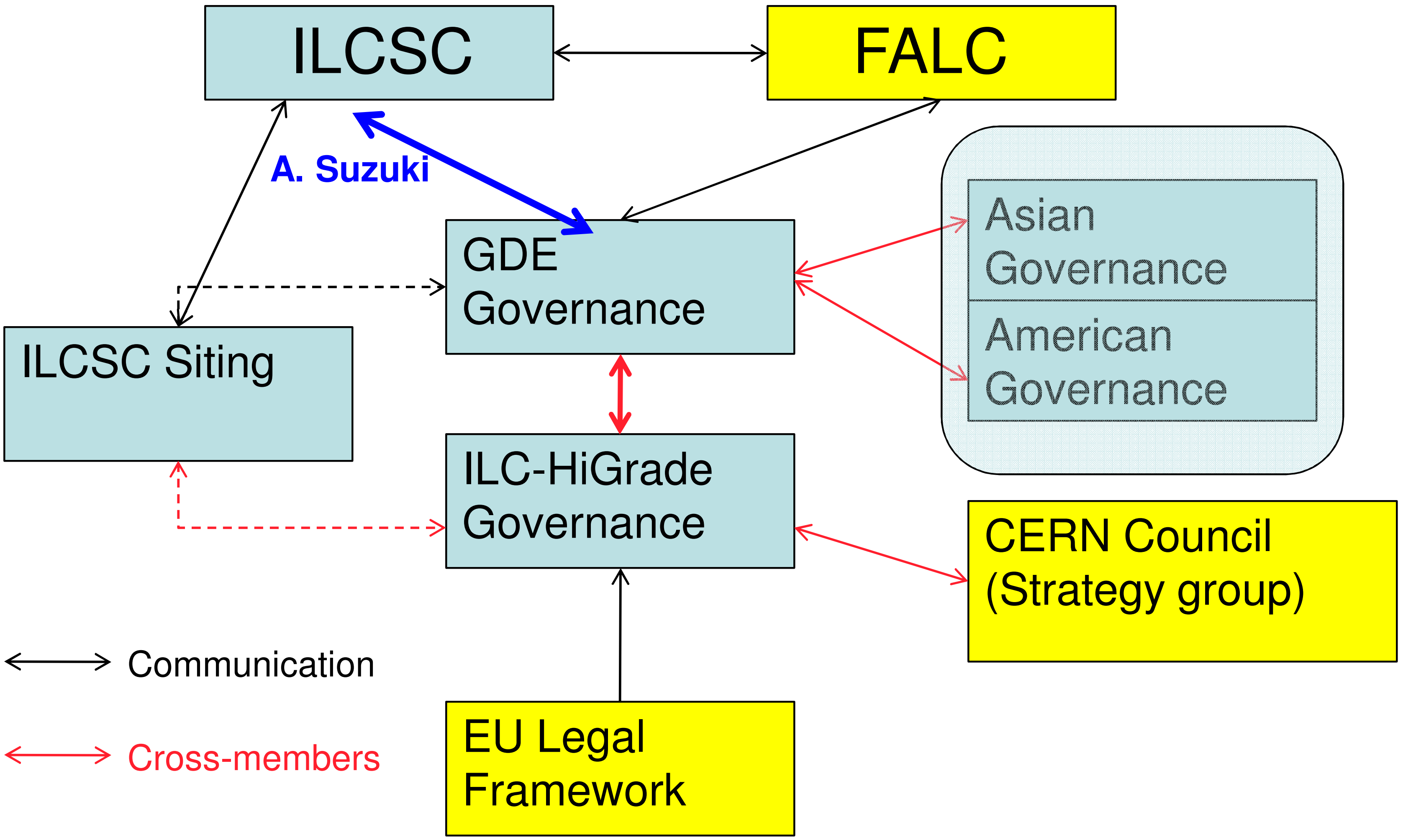


Example Result

Project Implementation Plan



Governance



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Studies of other Large Projects

Inferences

1) **Achieving a consensus and implementing a method of governance is a long-drawn-out and complex process. It needs strong involvement and buy-in from funding authorities and governments at all stages. The statement of the OECD science ministers in 2004: ".. They agreed that the planning and implementation of such a large, multi-year project should be carried out on a global basis, and should involve consultations among not just scientists, but also representatives of science funding agencies from interested countries. Accordingly, Ministers endorsed the statement prepared by the OECD Global Science Forum Consultative Group on High-Energy Physics…" is important in this regard.**

2) **All the schemes explored by the monitored projects seem to be viable, including negotiation of an international treaty (ITER) and foundation of a company with limited liability (XFEL, FAIR). There does not seem to be much difference in the complexity of time taken between the various options : n.b. DoE in US has signed the ITER treaty.**

3) **The ILC laboratory has to have its own legal standing as a legal entity and the ability to hire staff directly. Questions such as pension rights, tax status need to be solved well in advance of setting up the organisation.**

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Studies of other Large Projects

Inferences

4) Strong management structure essential, with clear responsibles and delegation down to appropriate level for decision making. Clear reporting paths to single bodies. Appropriate regional management structures need to be considered.

5) In-kind contributions will have important role in project. Essential to have large enough common fund to be able to react to changes in cost estimates and have enough management flexibility to be able to optimise resources. Need agreement on how to deal with cost changes on particular items.

6) Need common project management tools and well defined procedure to make changes in projects specification if necessary as development progresses.

7) Need early agreement on site selection procedure, which should be extremely well defined and call for site proposals with an agreed timetable.

8) Do not under-estimate the length of time taken e.g. to agree on official translations of documents to by signed by partners across the world!

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Related Studies

The EU initiative on European Scientific Infrastructures mentioned in context of ESS – will be important for future European Infrastructures but not directly applicable for fully international projects such as ILC – nevertheless, interesting for ILC.

CERN Council Strategy Group – planning to revise current European Plan, taking close account of world situation, in around 2012. Fits in well with GDE plans.

OECD study – OECD Megascience forum, in particular secretariat led by S. Michelowski, intend to produce study on large international infrastructures. Good contacts between GDE and OECD and will work closely together as this work continues.

Timescales

1) Albuquerque Sep 29 – Oct 3 – tentative conclusion on funding model – fractions per partner, size of common fund etc.

2) EC face-to-face ~ Jan. Oxford – conclusion on funding models, preliminary conclusion on governance model options

3) Beijing March/April 2010? – conclusion on governance model options

4) Write preliminary governance report and iterate May – June 2010

5) Present to and hope to get agreement from ICFA, ILCSC, PAC & FALC – June-July 2010?

6) Present at Paris ICHEP July 2010 – N.B. this is not a final report and no funding authority/government will be expected to sign off on it. Comments/criticisms etc however would be *very* welcome.

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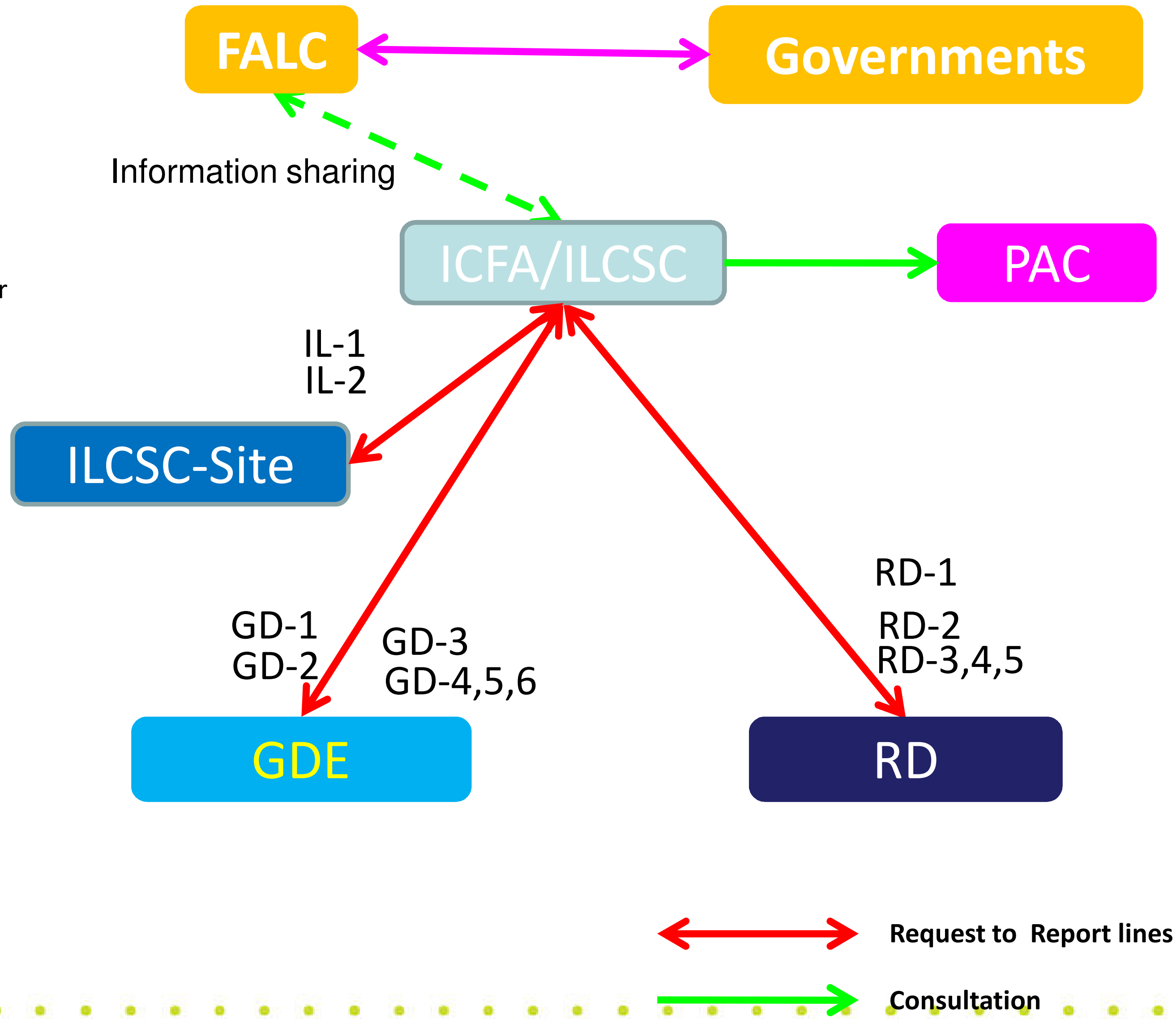
ILCSC (Suzuki)

– Organize Three Streams –

Governance	**High-level organization and its connection to participating parties.**
Siting	**Technical, social and procedural issues on the site consideration.**
Construction	**Technical aspects of construction of the accelerator and the detectors**

View points	Inter-Government	General issues + desirable features	Technical requirements

Proposed Organization
Work-Packaging and Job Sharing



IL-1 Top-level management structure (government – research)

IL-2: Siting process (required and/or desirable processes)

GD-1: Sharing models from Technical View points

GD-2: Management models from Technical View points Acc.

GD-3: Siting from Technical View points

GD-4,5,6: Construction process technical

RD-1: Management models from Technical View points Det./Exp.

RD-2: Siting issues from living environment (desirable features)

ILC- CLIC Collaboration

- CLIC – ILC Collaboration has two basic purposes:
  1. **allow a more efficient use of resources, especially engineers**
     - **CFS / CES**
     - **Beamline components (magnets, instrumentation…)**
  2. **promote communication between the two project teams.**
     - **Comparative discussions and presentations will occur**
     - **Good understanding of each other's technical issues is necessary**
     - **Communication network – at several levels – supports it**
- Seven working groups which are led by conveners from both projects

Collaboration Working Groups

	CLIC	ILC
Physics & Detectors	L.Linssen, D.Schlatter	F.Richard, S.Yamada
Beam Delivery System (BDS) & Machine Detector Interface (MDI)	L.Gatignon D.Schulte, R.Tomas Garcia	B.Parker, A.Seriy
Civil Engineering & Conventional Facilities	C.Hauviller, J.Osborne.	J.Osborne, V.Kuchler
Positron Generation	L.Rinolfi	J.Clarke
Damping Rings	Y.Papaphilipou	M.Palmer
Beam Dynamics	D.Schulte	A.Latina, K.Kubo, N.Walker
Cost & Schedule	P.Lebrun, K.Foraz, G.Riddone	J.Carwardine, P.Garbincius, T.Shidara

ILC / CLIC – Future Directions

- A recent management meeting at CERN reviewed collaborative status and looked at possible areas for additional co-operation.

- Conclusions from that meeting include:
  - **The existing working groups were deemed a success and we added two more (damping rings & positron production)**
  - **Jean Pierre Delahaye (CLIC Study Leader) has joined the GDE EC, and Brian Foster (European Regional Director) has joined the CLIC steering committee.**
  - **We plan to hold joint ILC/CLIC management meeting,**
  -

- There was discussion about creating a joint linear collider program general issues subgroup encompassing both the ILC and CLIC programs. A joint statement has been endorsed by ILCSC and the CLIC Collaboraton Board.

CLIC / ILC Joint Working Group on General Issues

- ILCSC has approved formation of a CLIC/ILC General Issues working group by the two parties with the following mandate:
  - **Promoting the Linear Collider**
  - **Identifying synergies to enable the design concepts of ILC and CLIC to be prepared efficiently**
  - **Discussing detailed plans for the ILC and CLIC efforts, in order to identify common issues regarding siting, technical issues and project planning.**
  - **Discussing issues that will be part of each project implementation plan**
  - **Identifying points of comparison between the two approaches .**
- The conclusions of the working group will be reported to the ILCSC and CLIC Collaboration Board with a goal to producing a joint document.

Summary / Conclusions

- We are on track to be able to ready to propose the ILC on a time scale of ~2012 (or before!)
  - GDE R&D demonstrations (SCRF gradient; S1 FLASH)
  - Cost/risk/performance optimized design concept (AD&I)
  - Detector LOIs → Machine Detector Interfaces
  - Re-baseline (2010)
  - Technical Design Report (end of 2012)
  - Project Implementation Plan (end of 2012)

  - LHC results to motivate the project
  - Outreach to generate support from science community, funding agencies, etc