Global Design Effort

Overview

Barry Barish

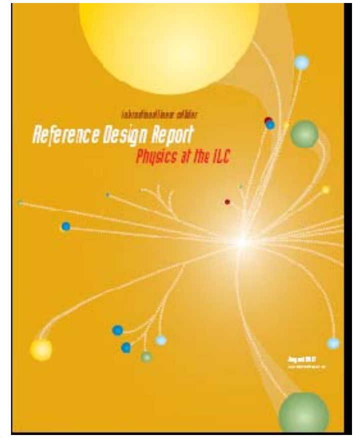
AAP Review - Tsukuba

17-21 April 09

RDR – The Starting Point

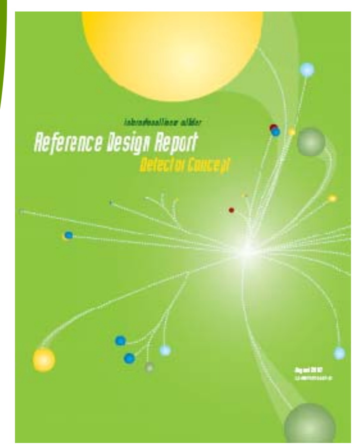
- Reference Design Report (4 volumes)

Executive Summary



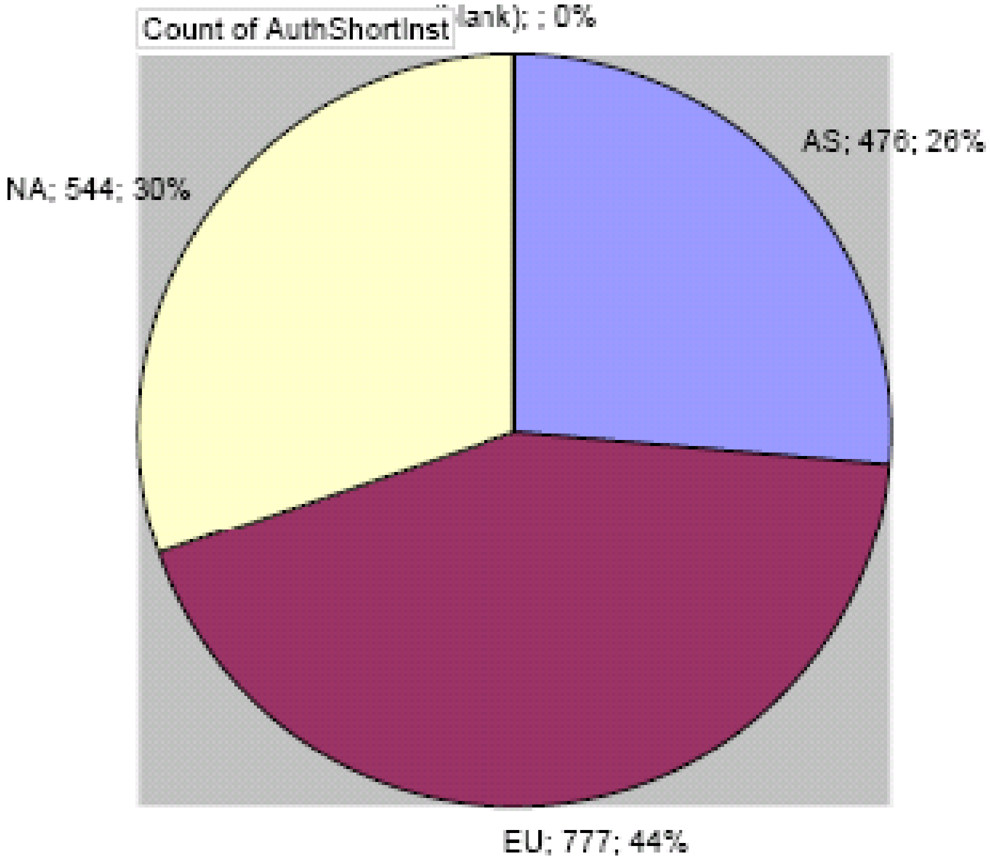
Physics at the ILC

Accelerator



Detectors

RDR Author List



- **Asia 476**
- **Americas 544**
- **Europe 777**

- **TOTAL 1797**

How the physics defines the ILC

Parameters for the Linear Collider

September 30, 2003

Asia: Sachio Komamiya, Dongchul Son
Europe : Rolf Heuer (chair), Francois Richard
North America: Paul Grannis, Mark Oreglia

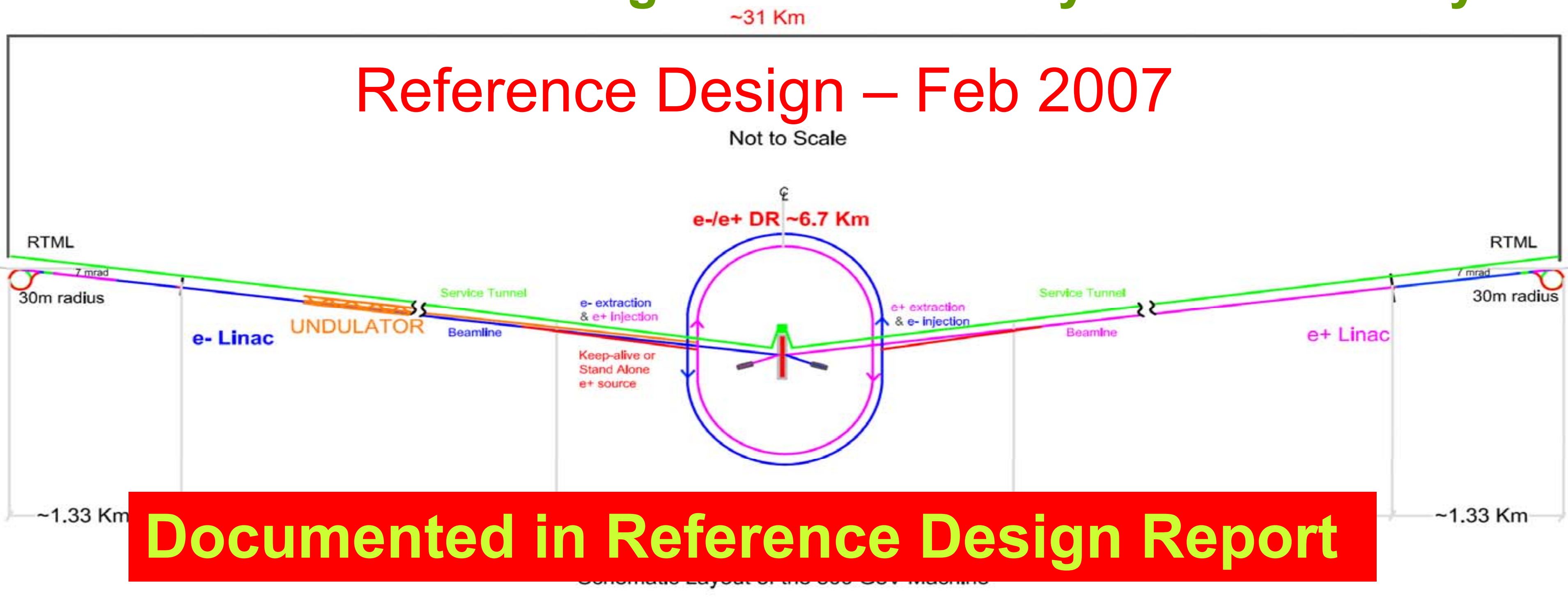
ILC Physics Goals

- E_{cm} adjustable from 200 – 500 GeV
- Luminosity → $\int L dt$ = 500 fb^{-1} in 4 years
- Ability to scan between 200 and 500 GeV
- Energy stability and precision below 0.1%
- Electron polarization of at least 80%

The Reference Design meets the goals of the ICFA- ILCSC parameters study

TDP Starting Point: ILC RDR

- 11km SC linacs operating at 31.5 MV/m for 500 GeV
- Centralized injector
  - Circular damping rings for electrons and positrons
  - Undulator-based positron source
- Single IR with 14 mrad crossing angle
- Dual tunnel configuration for safety and availability



RDR Design Parameters

Max. Center-of-mass energy	500	GeV
Peak Luminosity	$\sim 2 \times 10^{34}$	$1/cm^2s$
Beam Current	9.0	mA
Repetition rate	5	Hz
Average accelerating gradient	31.5	MV/m
Beam pulse length	0.95	ms
Total Site Length	31	km
Total AC Power Consumption	~230	MW

Assessment of the RDR

- **Reviews (5 major international reviews + regional)**
  - **The Design:** "The MAC applauds that considerable evolution of the design was achieved … the performance driven baseline configuration was successfully converted into a cost conscious design."
  - **The R&D Plan:** "The committee endorses the approach of collecting R&D items as proposed by the collaborators, categorizing them, prioritizing them, and seeking contact with funding agencies to provide guidelines for funding.
  - **International Cost Review (Orsay):** Supported the costing methodology; considered the costing conservative in that they identify opportunities for cost savings; etc.

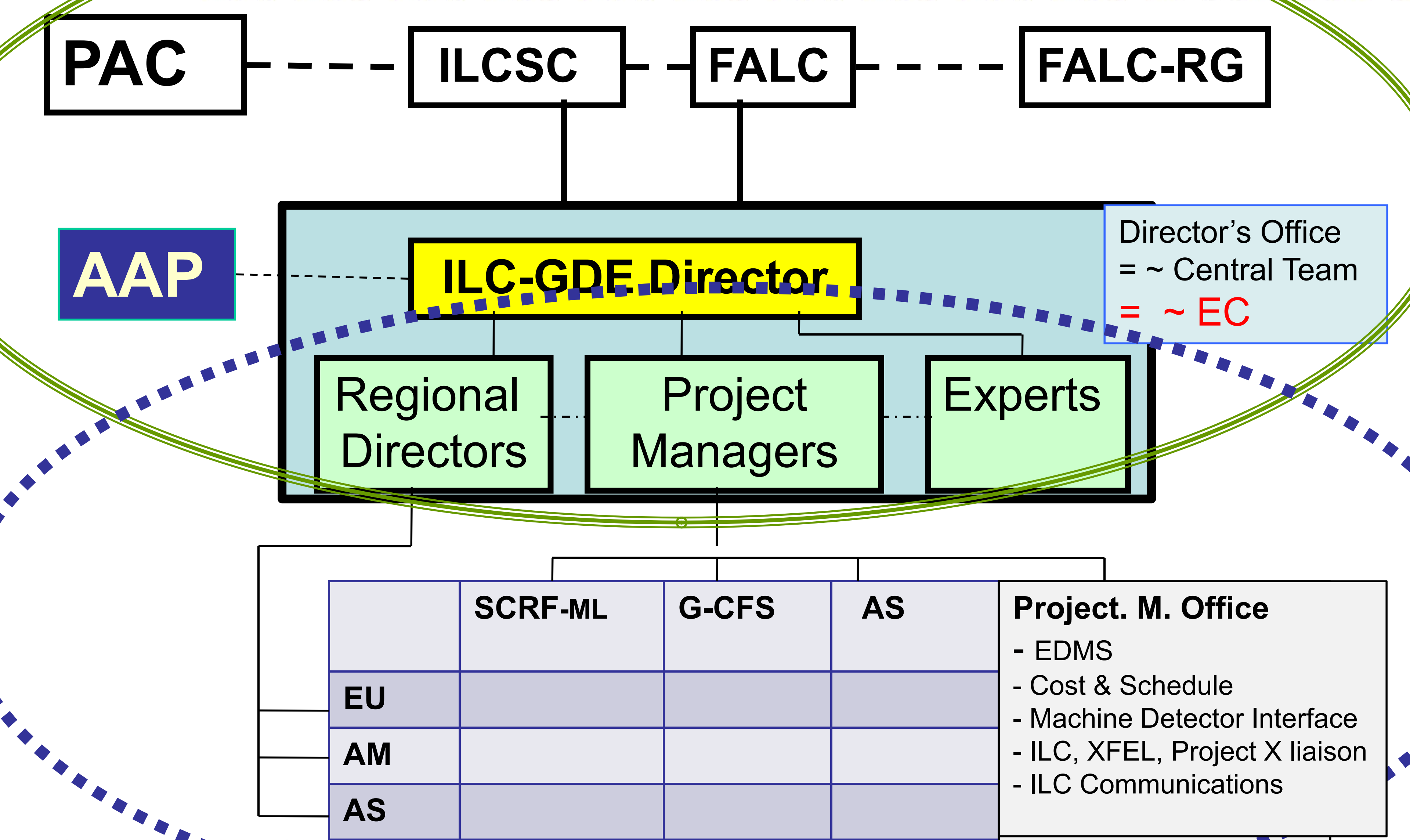
- **Final Steps**
  - The final versions of Executive Summary, Reference Design Report and Companion Document were submitted to FALC and to ILCSC and ICFA and they were approved.

How are we moving forward?

*Our General Theme is **RISK REDUCTION***

- We are prioritizing the R&D program such that the major technical questions (gradient, electron cloud, etc) will be positively resolved
- We are re-examining the ILC RDR design to optimize for cost to risk to performance. This will do this openly and in full coordination with experimentalists and will lead to a new baseline
- We will develop the technical design toward a construction proposal (plug compatible designs, value engineered concepts, etc.)
- Finally, we will develop an attractive, realistic and flexible Project Implementation Plan

GDE Overview



From Annex to ILCSC MOU

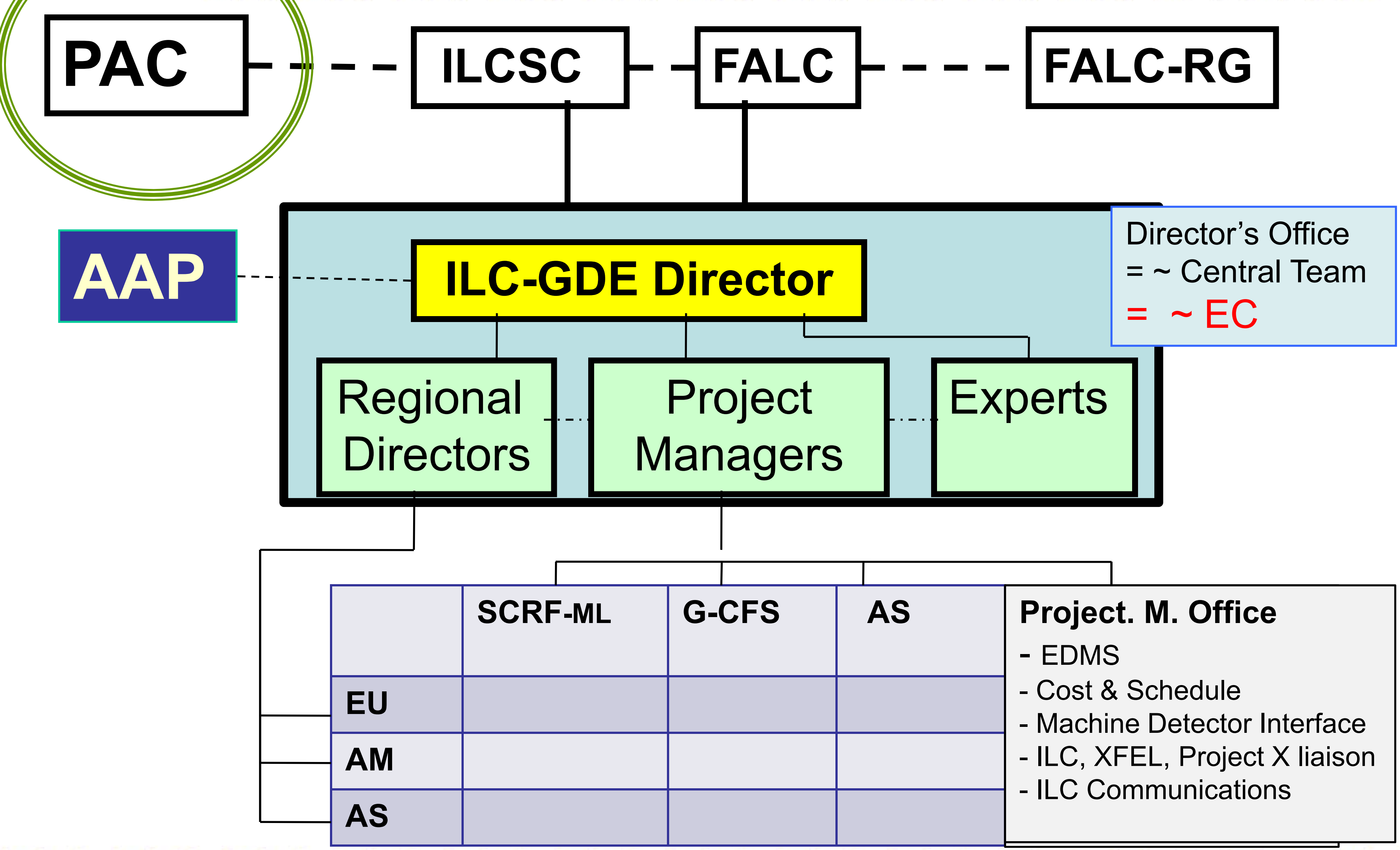
- 3. Composition of the Central Team

  3.1 The Central Team shall be led by the Central Team Director, who shall be selected and appointed by the ILCSC, having received recommendations from the Regional Steering Committees.

  3.2 The Central Team Director shall appoint three Regional Directors, each nominated by the Regional Steering Committee of his or her region. Each Regional Director shall become a member of the Central Team and shall facilitate the GDE in his or her region.

  3.4 The Central Team shall have its own staff, including (a) Project Manager(s), who shall assist the Central Team in the execution of its duties.

Project Advisory Committee (PAC)



ILCSC - PAC Mandate

- **ILC Project Advisory Committee (PAC) Mandate**
  - 1. The International Linear Collider Steering Committee (ILCSC) is responsible for the oversight of the Global Design Effort (GDE) activities and of the ILC experimental program.
  - 2. PAC will assist ILCSC in this function and report to the ILCSC.
  - 3. PAC will review the GDE accelerator activities and, in addition, the ILC detector activities.
  - 4. In its review activity, PAC will examine the overall consistency and realism of the project, in relation to physics, technical design, cost, and schedule.
  - 5. PAC shall comprise about nine members, appointed by the ILCSC for terms of two or three years, and will meet a few times per year until the completion of the Technical Design Phases I and II.
  - 6. The PAC Chair will be appointed by the ILCSC, normally for a two-year term.

1st PAC Review & Report (Oct 2008)

- **Committee:**
  - Jean-Eudes Augustin, Paris (Chair); Günther Geschonke, CERN; Don Hartill, Cornell; Steve Holmes, Fermilab; Enzo Iarocci, Rome (ILCSC Chair—ex officio); Akira Masaike, Kyoto; Robert Orr, Toronto; Raj Pillay, TIFR; Roy Rubinstein, Fermilab (Secretary); Masakazu Yoshioka, KEK.. Apology: Lyn Evans, CERN

- **PAC Summary and Recommendations**
  - General: The PAC views very positively the recent start of common activities between the ILC and CLIC on many items such as conventional facilities, beam delivery system, detectors, physics, cost estimation, etc. This avoids unnecessary duplication of effort, and keeps the particle physics community focused on the goal of a linear collider as the next major new facility for the field

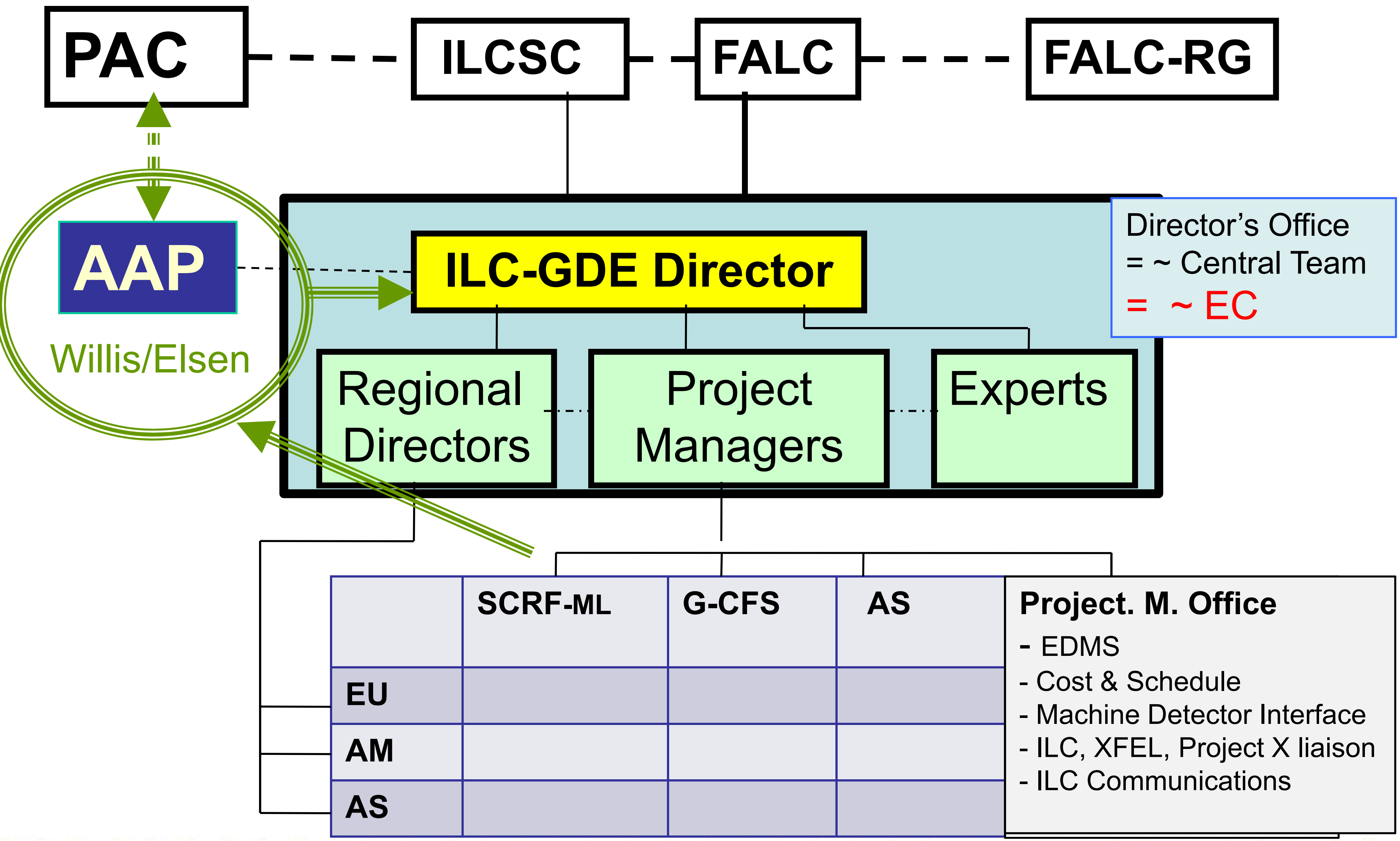
1st PAC Review Report (Oct 2008)

- **Accelerator:**
  - The PAC believes that the appointment of the three Project Managers, and the formation of the Accelerator Advisory Panel (AAP) for internal advice to the GDE Director, significantly strengthen the GDE organization as it moves into the Technical Design Phase.
  - The current TDP schedule, with reporting dates of 2010 and 2012, is fixed by outside constraints, and the PAC concurs with the result.
  - The GDE is to be commended for its efforts to bring about worldwide collaboration among labs on SCRF, BDS, DR, etc. The ILCSC should support the international use of test facilities such as CESRTA, TTF/FLASH, ATF2, STF, ILCTA_NML, and others.
  - The PAC is very positive about the GDE concept of plug compatibility, especially for SC cavities. It notes that GDE will need to monitor the large flexibility that this concept could allow.

1st PAC Review Report (Oct 2008)

- **Accelerator: (continued)**
  - The S1 test organization appears to be a success, and the PAC looks forward to hearing of progress and a schedule for S2.
  - The PAC endorses research on SC cavity processing, and also notes the importance of obtaining good statistical data; this will be helped by the experience which will be obtained on the XFEL project construction.
  - The flow of information on SC cavity processing and tests between labs is strongly encouraged. The same is true for information from industry, although the PAC acknowledges the difficulties that may arise in this case.
  - The PAC notes with interest the recent GDE efforts on a "Minimum Machine" and cost-reduction; it welcomes the study of the single-tunnel concept, and other studies on simplifications to the accelerator facility. While cost reduction is important, the PAC notes that this may not necessarily be desirable if it leads to more risk, or precludes some future options such as eventually achieving the beam current specification or 1 TeV operation.

AAP


PAC
ILCSC
FALC
FALC-RG
AAP
Willis/Elsen
ILC-GDE Director
Director's Office
= ~ Central Team
= ~ EC
Regional Directors
Project Managers
Experts
SCRF-ML
G-CFS
AS
EU
AM
AS
Project. M. Office
- EDMS
- Cost & Schedule
- Machine Detector Interface
- ILC, XFEL, Project X liaison
- ILC Communications

AAP Charge

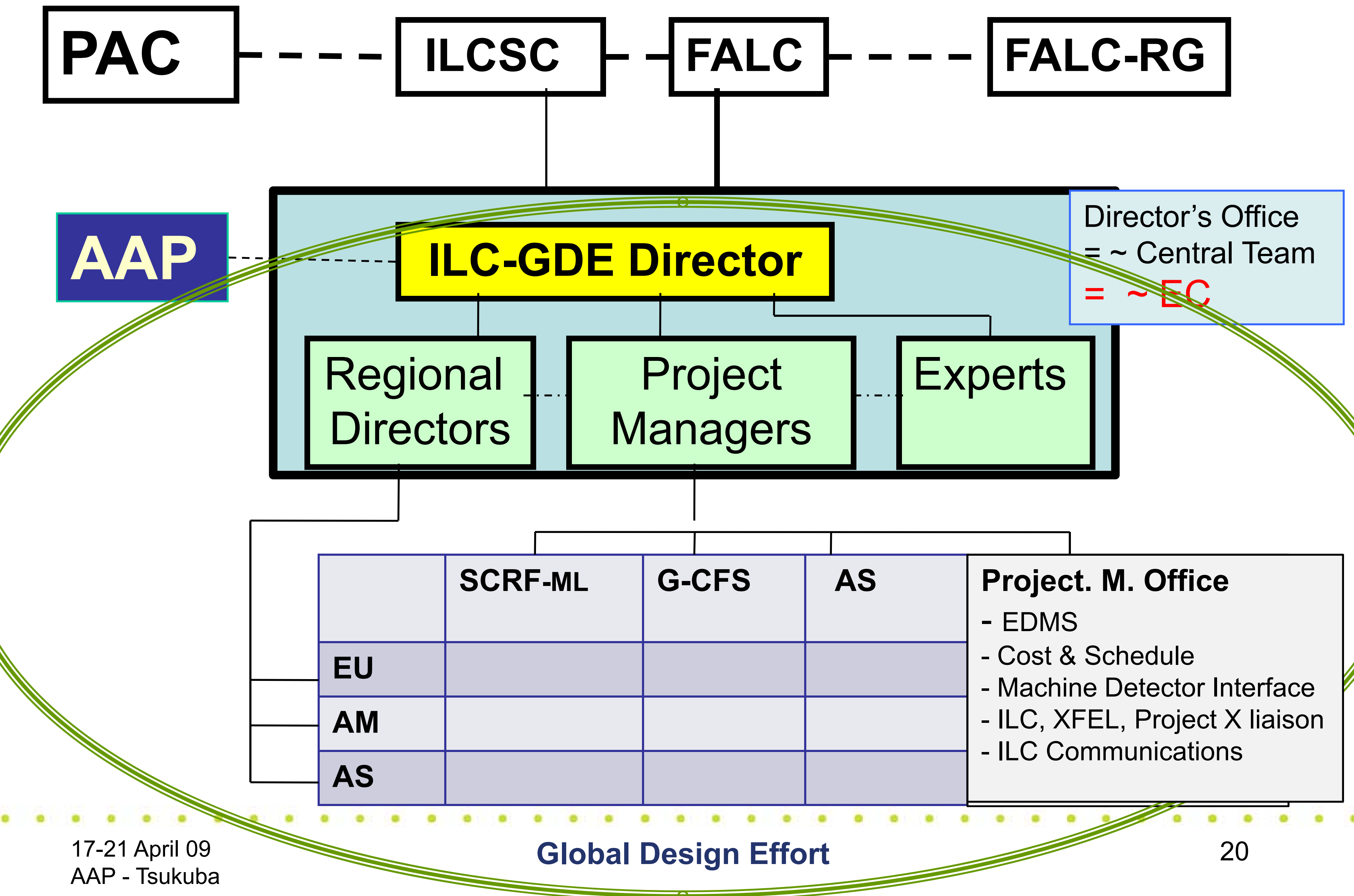
- The Accelerator Advisory Panel (AAP) is a panel appointed by the project director, from within or external to the ILC community, to advise him and the project managers on technical issues regarding the accelerator. Research, development, engineering, design, and industrialization and operation issues would all be addressed by the AAP, in line with the current implementation plan of the Project Management.

- The panel serves as an advisory body and a tool for the project to address reviews and interfaces, which periodically reports to the GDE Director, who may request the AAP to investigate particular issues. Some members will participate in the Technical Area Group Meetings, thus keeping the whole AAP up to date.

AAP Charge (2)

- The AAP meets regularly (typically once a month) to discuss progress. Minutes of the meetings are made available to the Director. If adequate or on request the panel will issue additional reports to the Director.
- Typically once a year, the AAP carries out a major in-depth review of the ILC project. Along with the technical aspects the project management and project plan are addressed. For this matter the AAP is augmented by technical and project experts. These experts are nominated after consultation with the Director. The reviews are preceded by exhaustive documentation that address the goals of the specific period. The review is summarised in a written report to the Director. If the Director so decides these reports can be made available to other committees.

Project Coordination/Management



The Project Managment

- **GDE has been reorganized around a GDE Project Management Office to reach this goal**
- **Project Managers: Marc Ross, Nick Walker and Akira Yamamoto**
  - **Central management being given the authority to set priorities and coordinate the work**
  - **Resources for the technical design and associated R&D are limited, but program goals have been keyed to our best estimate of available resources.**
  - **Anticipate LHC results by about 2012 when we plan to be ready to pursue a robust proposal to our governments**
  - **Investments are needed toward Industrialization and siting**

Project Management Plan

ILC Project Management Plan for the Engineering Design (ED) Phase

International Linear Collider Project Management Team

M Ross, N Walker, A Yamamoto, Project Managers

Purpose

This document describes the organization and processes that will be used to complete the Engineering Design Phase of the ILC Global Design Effort.

As the project progresses, the Project Management Plan will be periodically reviewed, and subsequently revised as needed.

Release 2.0 dated 15 Oct 2007.

http://ilcdoc.linearcollider.org/record/11980

R&D Plan - Technical Design Phase


ILC Research and Development Plan for the Technical Design Phase

Release 3

February 2009

ILC Global Design Effort

Director: Barry Barish

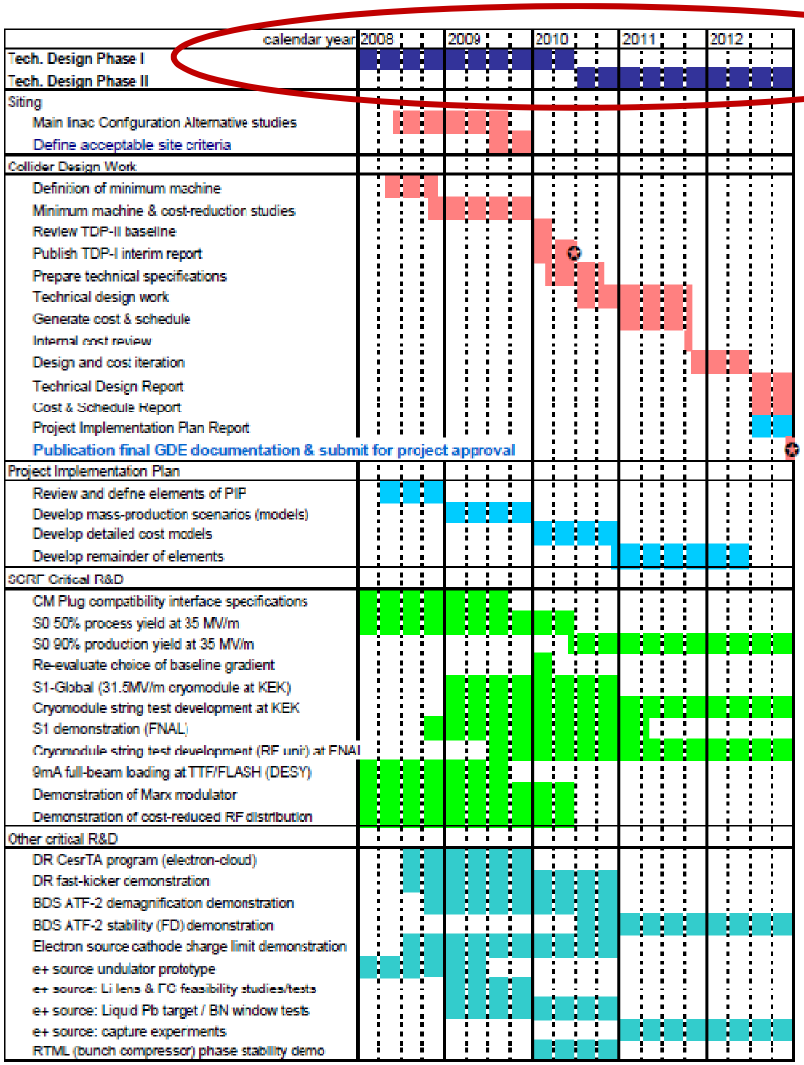
Prepared by the Technical Design Phase Project Management

Project Managers: Marc Ross, Nick Walker, Akira Yamamoto

- "Living Document"
- A 60 page document with details of all R&D programs, schedules and resources.
- **New: Release 3**

- Technical Design Phase
  - **Phase 1 2010 (critical R&D demonstrations; new baseline**
  - **Phase 2 2012 (technical design and implementation plan –> construction proposal ready**

Our Plan with goals and dates



Basic time-scale

- **Phase 1: July 2010**
  - **Paris meeting already scheduled**
- **Phase 2: end of CY 2012**
  - **Not previously well-defined**
  - **Fits with current SCRF planning with some exceptions (S2 , positrons?)**

Encapsulates the PMs strategy and vision for the next four years

- **Critical R&D**
- **Cost reduction / machine design**
- **Project Implementation Plan**

ILC R&D Major Test Facilites

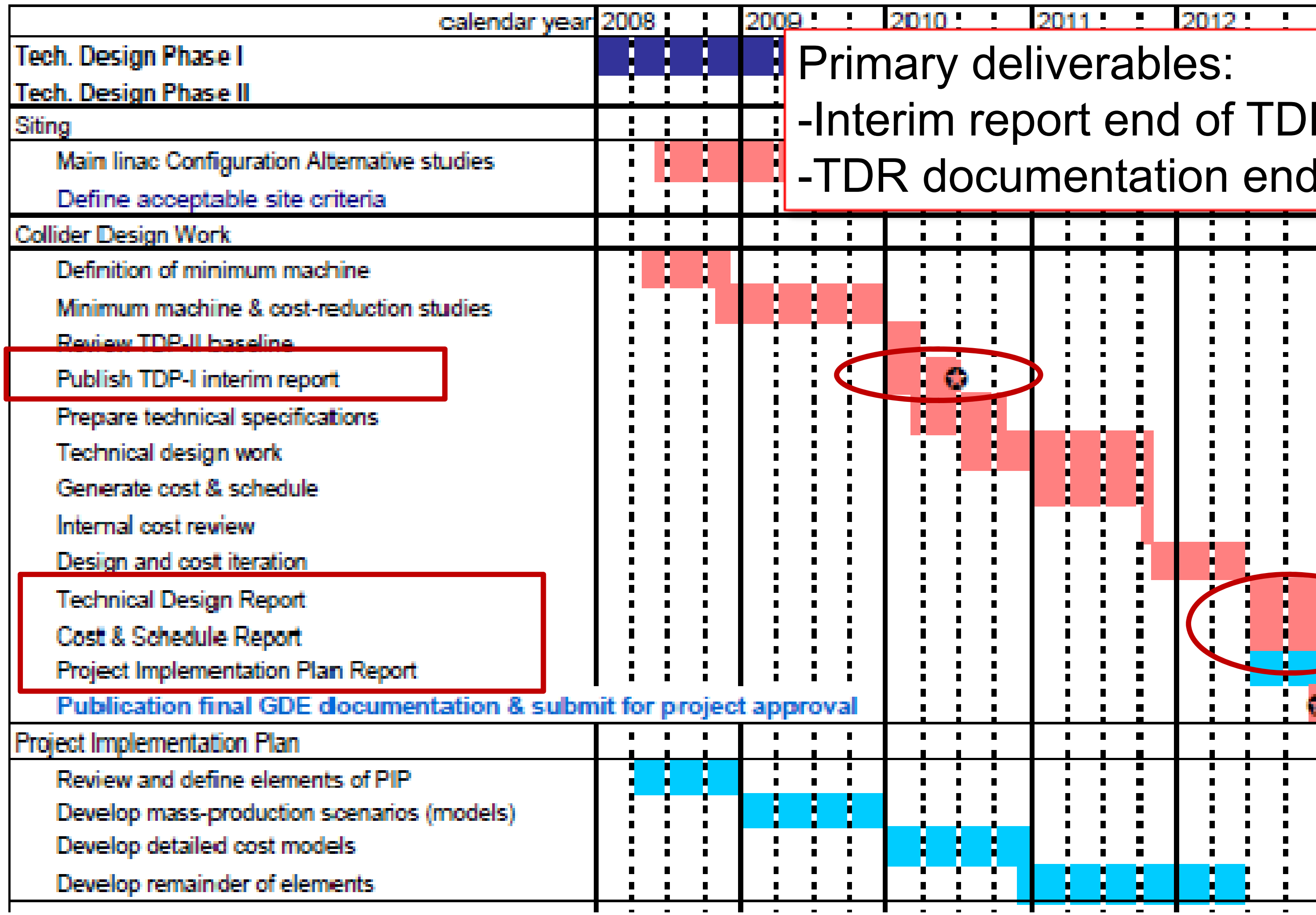
Table 3-2: Beam Test Facilities (existing or under construction).

Test Facility	Acronym	Purpose	Host Lab	Operation start	Organized through:
Accelerator Test Facility	ATF	Damping Ring	KEK	1997	ATF Collaboration
Cornell Test Accelerator	CESR-TA	Damping Ring	Cornell	2008	Cornell
Superconducting RF Test Facility	STF	Main linac	KEK	2008	KEK
TESLA Test Facility/ Free Electron Laser Hamburg	TTF / FLASH	Main linac	DESY	1997	TESLA Collaboration, DESY
ILC Test Accelerator	ILCTA-NML	Main Linac	FNAL	2009	Fermilab
Beam Delivery Test Facility	ATF-2	Beam Delivery	KEK	2008	ATF Collaboration
End Station A	ILC-SLACESA	Machine detector Interface	SLAC	2006	SLAC

R&D Test Facilities Deliverables

Test Facility	Deliverable	Date
Optics and stabilisation demonstrations:		
ATF	Generation of 1 pm-rad low emittance beam	2009
ATF-2	Demonstration of compact Final Focus optics (design demagnification, resulting in a nominal 35 nm beam size at focal point).	2010
	Demonstration of prototype SC and PM final doublet magnets	2012
	Stabilisation of 35 nm beam over various time scales.	2012
Linac high-gradient operation and system demonstrations:		
TTF/FLASH	Full 9 mA, 1 GeV, high-repetition rate operation	2009
STF & ILCTA-NML	Cavity-string test within one cryomodule (S1 and S1-global)	2010
	Cryomodule-string test with one RF Unit with beam (S2)	2012
Electron cloud mitigation studies:		
CESR-TA	Re-configuration (re-build) of CESR as low-emittance e-cloud test facility. First measurements of e-cloud build-up using instrumented sections in dipoles and drifts sections (large emittance).	2008
	Achieve lower emittance beams. Measurements of e-cloud build up in wiggler chambers.	2009
	Characterisation of e-cloud build-up and instability thresholds as a function of low vertical emittance (≤20 pm)	2010

Design / Cost Reduction / PIP

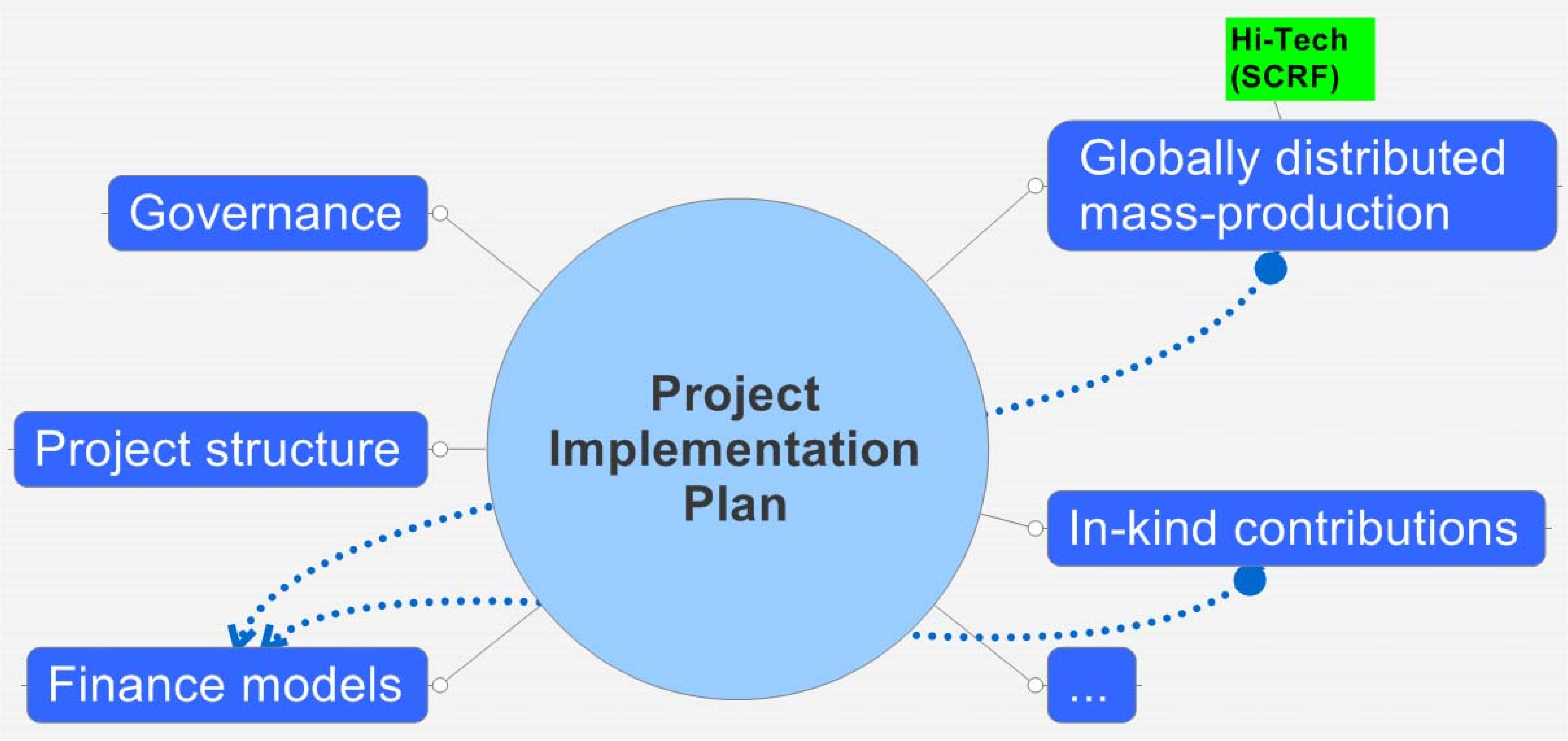


Primary deliverables:
-Interim report end of TDP-1
-TDR documentation end of TDP-

SCRF Major Goals

High-gradient cavity performance at 35 MV/m according to the specified chemical process with a process yield of 50% in TDP1, and with a production yield of 90% in TDP2 (S0, see section 3.1.3 for definition of process yield)	2010 2012
Plug-compatible Cryomodule internal and external interface specifications to be defined: - including considerations of tuneability and maintainability - thermal balance and cryogenics operation - beam dynamics (addressing issues such as orientation and alignment)	2009
Cavity-string performance in one cryomodule with the average gradient 31.5 MV based on a global effort (S1 and S1-global)	2010
Cryomodule-string performance achieving the average gradient 31.5 MV/m with full-beam loading and handling (S2)	2012

Project Implementation Plan



ECFA Governance Study

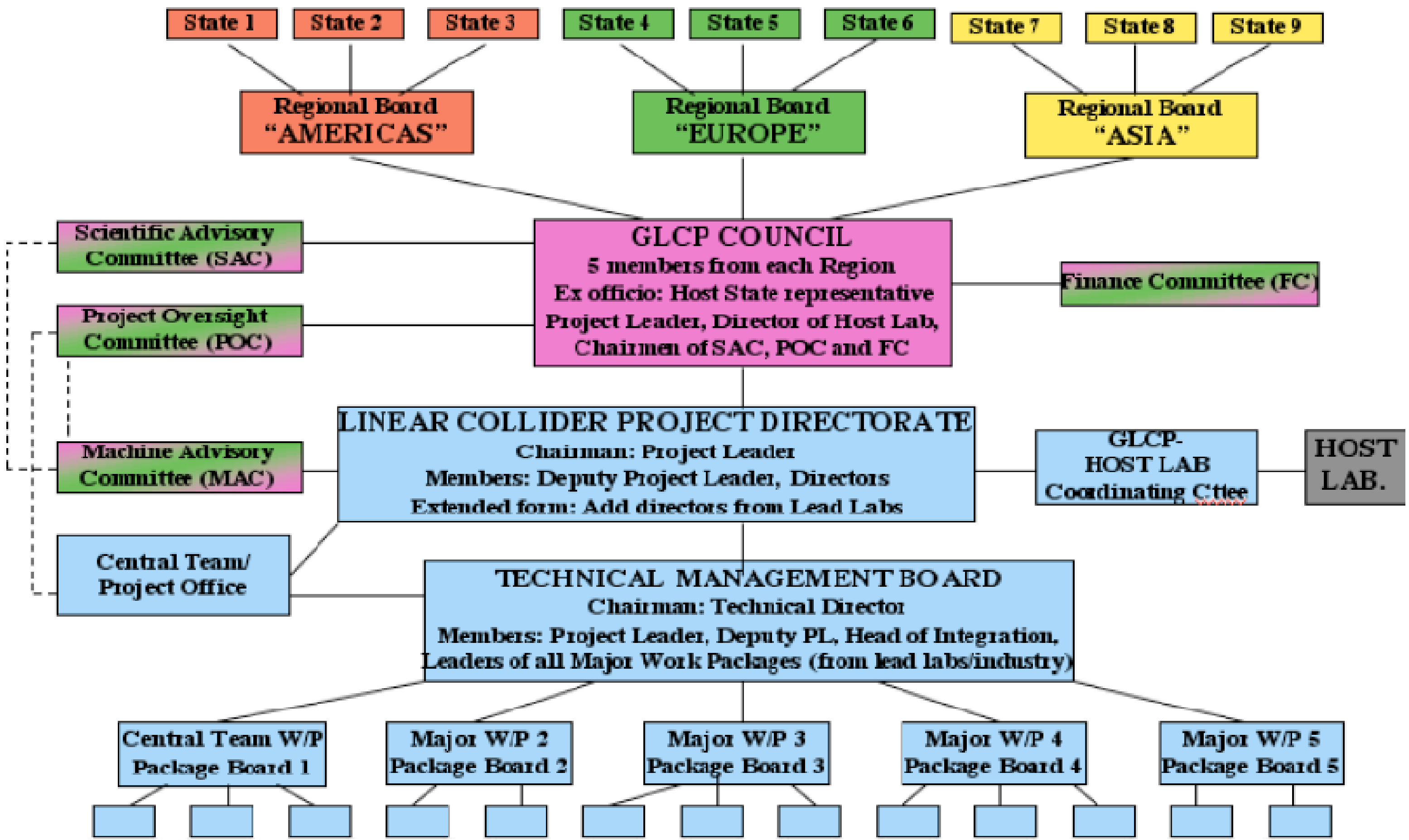
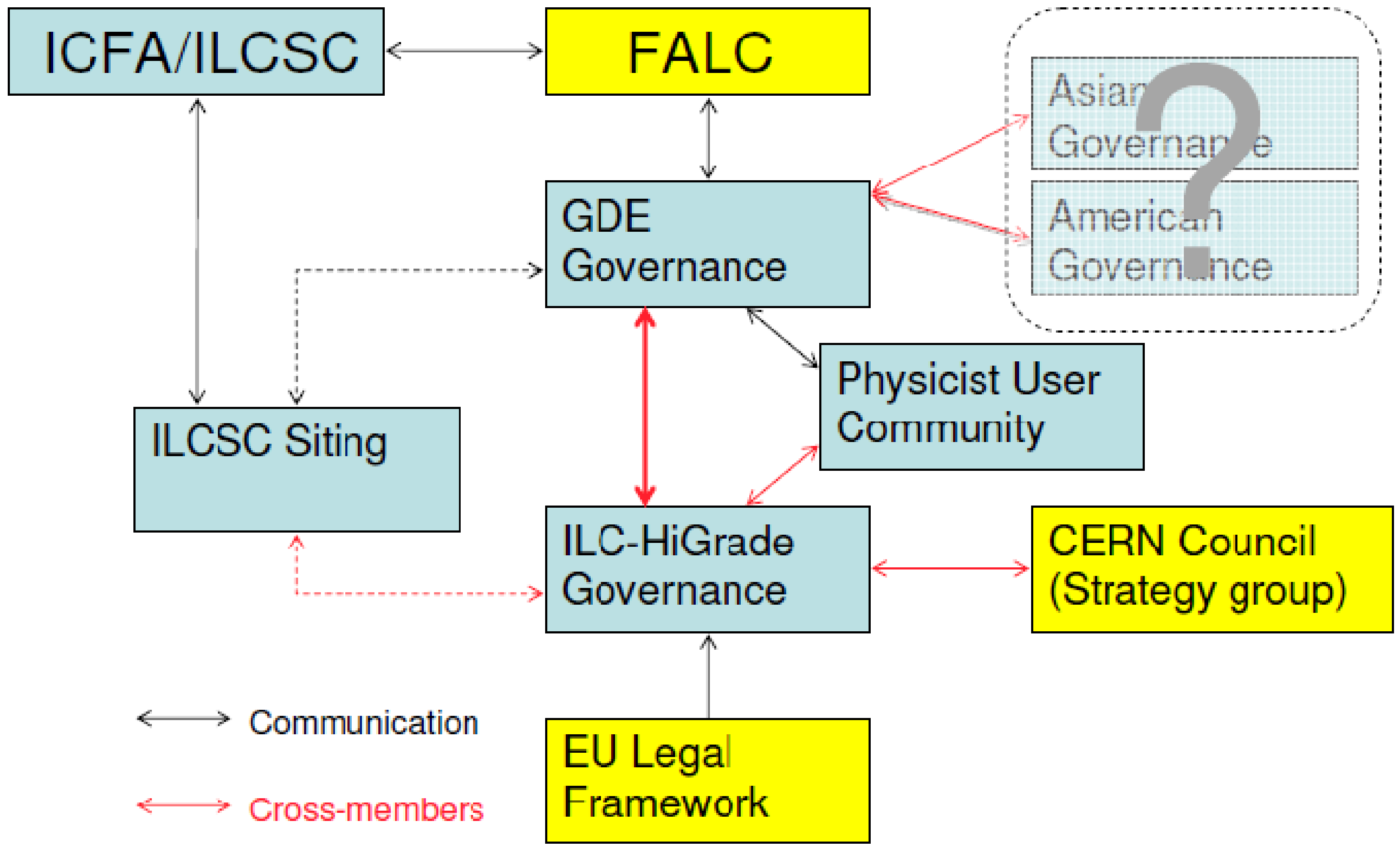


Fig. 1 Governance (GLCP Council and above), Management (Light blue boxes below GLPC Council) and Monitoring (Bi-coloured boxes) structure of the GLCP

Coordinated Effort ?



GDE – Initial Studies

Brian Foster coordinating GDE effort

- Examining the main recent projects approved/in preparation: ALMA, FAIR, ITER, SKA, XFEL…
- Contact made with key individuals in projects. Information gathered and presented.
- E.g. on funding - 2 main models for funding: Host (~50%) + regional contributions (2 x~25%) or Host (~50%)+member states

  (n x~10%) (ITER). Balance of in-kind/cash?

CLIC / ILC Joint Statements
27 October 2008

Purpose of these statements:

The CLIC and ILC Collaborations agree to work together, within the framework of the CLIC / ILC Collaboration, to outline comparative statements to be used in presenting their respective projects. The Collaboration members agree to limit statements made about each other's projects to specifically agreed upon statements such as those listed below:

- **Project design**

The CLIC and ILC projects both plan to release design documents in the coming years. The CLIC Conceptual Design Report is to be published in 2010. If the CLIC technology is demonstrated to be feasible, a CLIC Technical Design will then be launched for publication in a CLIC TDR by 2015. The ILC TDR will be published in 2012. The design reports are intended to summarize the R&D and project planning at that time and will serve as indicators of project readiness. Both TDRs are intended to be submitted to governments and associated funding agencies in order to seek project approval.

- **Test facilities and system tests**

The CLIC and ILC projects both have test facilities either in operation or under construction for the purpose of demonstrating the performance of key technical components or to allow system engineering and industrialization. For each project, R&D priorities and schedules have been defined and it is anticipated that milestones and progress will be reviewed and reported on by members of the community. The XFEL project, with the same technical basis as the ILC, although at a lower accelerating gradient, and 7% of the energy of one of the ILC linacs, is a large-scale system test and demonstration of the industrialization of the ILC linac technology. The CERN- based CTF3 project is a demonstration of the CLIC two beam technology, although at a lower beam power.

- **Technology maturity and risk**

The collaborations agree that the ILC technology is presently more mature and less risky than that of CLIC. There are plans to demonstrate, by 2010, the feasibility of CLIC technology and to reduce the associated risk in the future. The ILC collaboration will focus on consolidation of the technology for global mass-production. Both collaborations consider it essential to continue to develop both technologies for the foreseeable future.

- **Costing**

Project planners from the CLIC and ILC projects are developing common methodologies and tools with the intention of enabling the development of similarly-structured project planning and costing documents for each of the two projects. The two collaborations agree to make no public statements about the comparative cost numbers of the two machines until these project planning and costing documents are complete.

Barry C. Barish

Barry C. Barish
ILC-GDE Director

J-P. Delahaye
CLIC Study Leader

CLIC / ILC Collaboration

- Working Groups with joint leadership

- Accelerator Tech Areas
- Physics / Detectors
- Costing

- First progress reported last fall

Context

- **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)	D.Schulte, R.Tomas Garcia E.Tsesmelis	B.Parker, A.Seryi
Civil Engineering & Conventional Facilities	C.Hauviller, J.Osborne.	J.Osborne, V.Kuchler
Positron Generation (new 11/08)	L.Rinolfi	J.Clarke
Damping Rings (new 11/08)	Y.Papaphilipou	M.Palmer
Beam Dynamics	D.Schulte	A.Latina, K.Kubo, N.Walker
Cost & Schedule	H.Braun, K.Foraz, P. LeBrun	J.Carwardine, P.Garbincius, T.Shidara

AAP Review – Presentations

- ***Friday, April 17, 2009***
- 12:00 *Workshop Opening Plenary* (to be announced)
- 14:30 – 15:30 *The TDP-1 Interim Review* Project Director - Barish
- 15:30 – 16:30 *Project Manager Report* Project Manager - Ross
- ***Saturday, April 18, 2009***
- 09:30 – 12:00 *CFS* CFS TA Group Lead - Kuchler
- 14:00 – 15:30 *CesrTA TF / Electron Cloud* CesrTA TF Lead - Palmer
- 15:30 – 16:30 *FLASH Test Facility* FLASH TF Lead - Carwardine
- ***Sunday, April 19, 2009***
- 09:00 - 10:00 *ATF TF* ATF TF Lead - Seryi
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from Ross

Project Manager's Report

- **Role of R & D in the Technical Design Phase**
- **The new baseline – updating the Reference Design**
- **Focus Topics, Accelerator Systems and Minimum Machine ('Accelerator Design and Integration')**
  1. Electron Cloud
  2. Test Facilities
  3. Superconducting RF
  4. Conventional Facilities and Siting
- **TDP deliverables**
- **Review process**

Examples from Context

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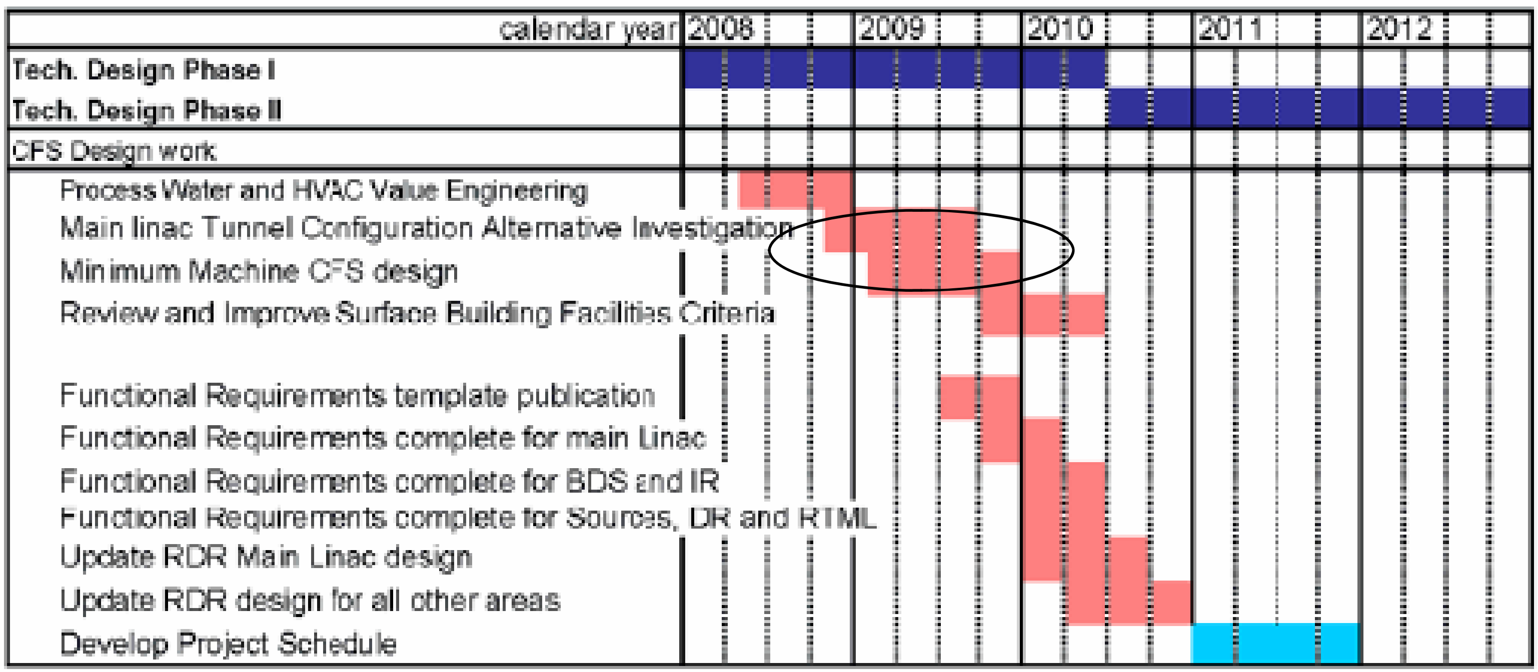
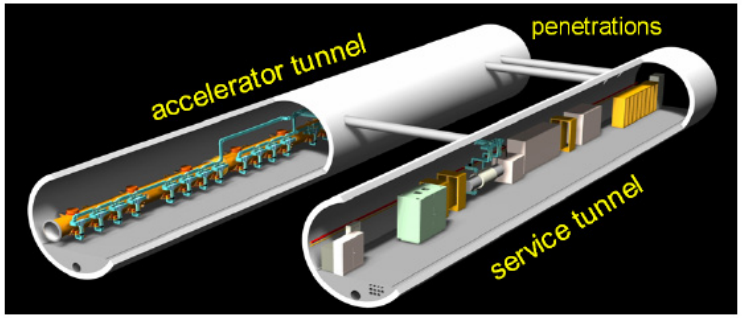
from Kuchler

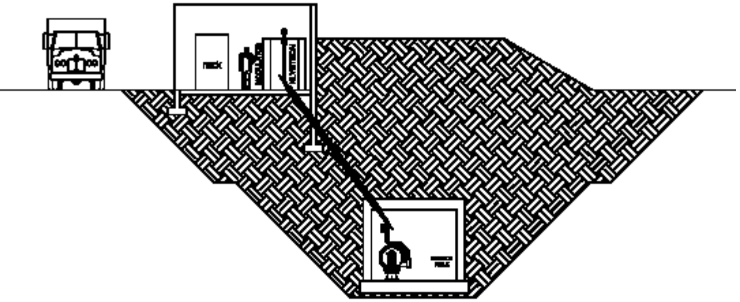
ILC R&D Plan CFS Milestones

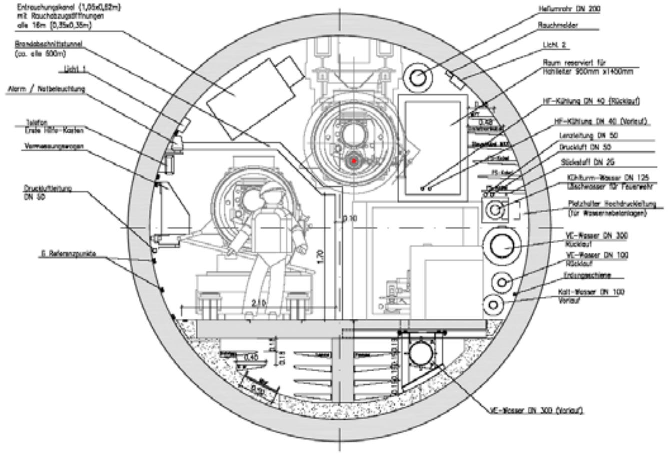
Table 4.1: Functional Requirements and Value Engineering Milestones (stages 1 & 2)



Main Linac & Support Tunnel







- RDR (two-tunnel)
  - **Access to equipment during ops**
    - Reliability/availability
- Shallow sites
  - **Cut and cover like solutions**
  - **"service tunnel" on the surface**
- Single tunnel
  - **European XFEL-like solution**
    - availability / reliability

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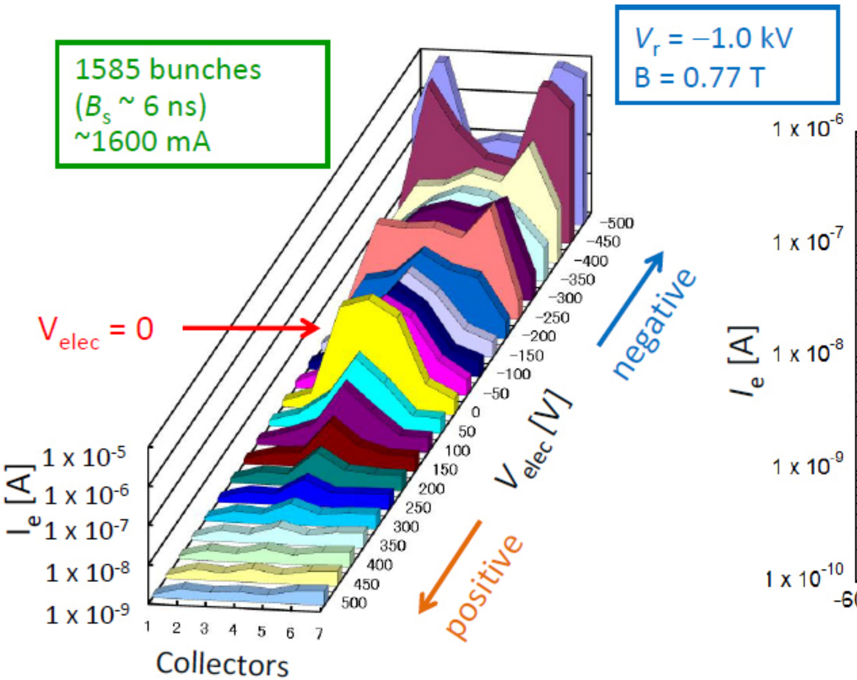
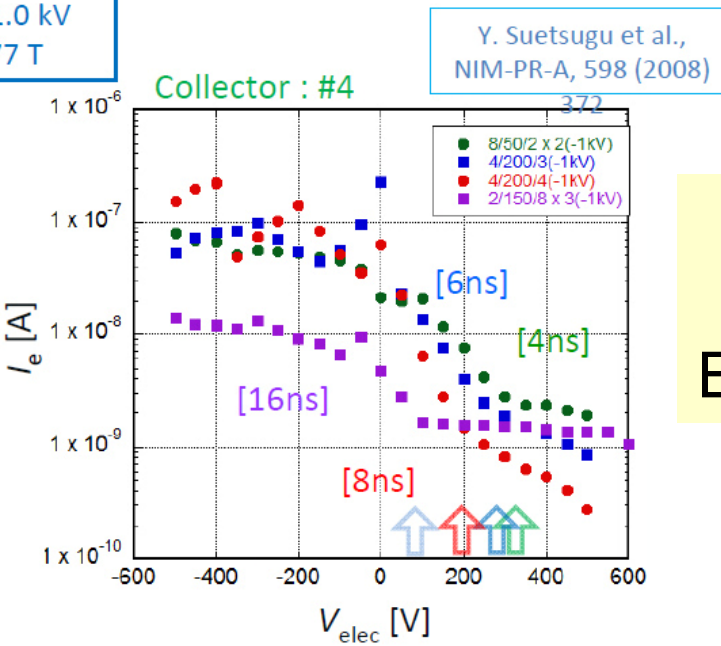
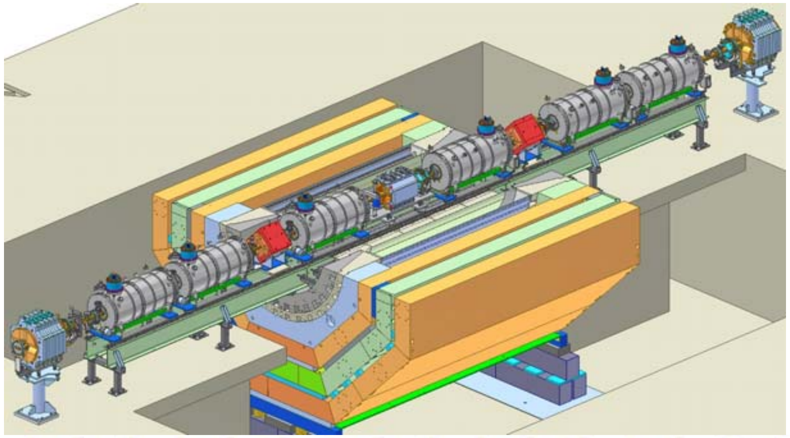
Electron Cloud – KEK-B Results





KEK-B Clearing Electrodes

CESR reconfigured to have 12 damping wigglers located in zero dispersion regions for ultra low emittance operation.



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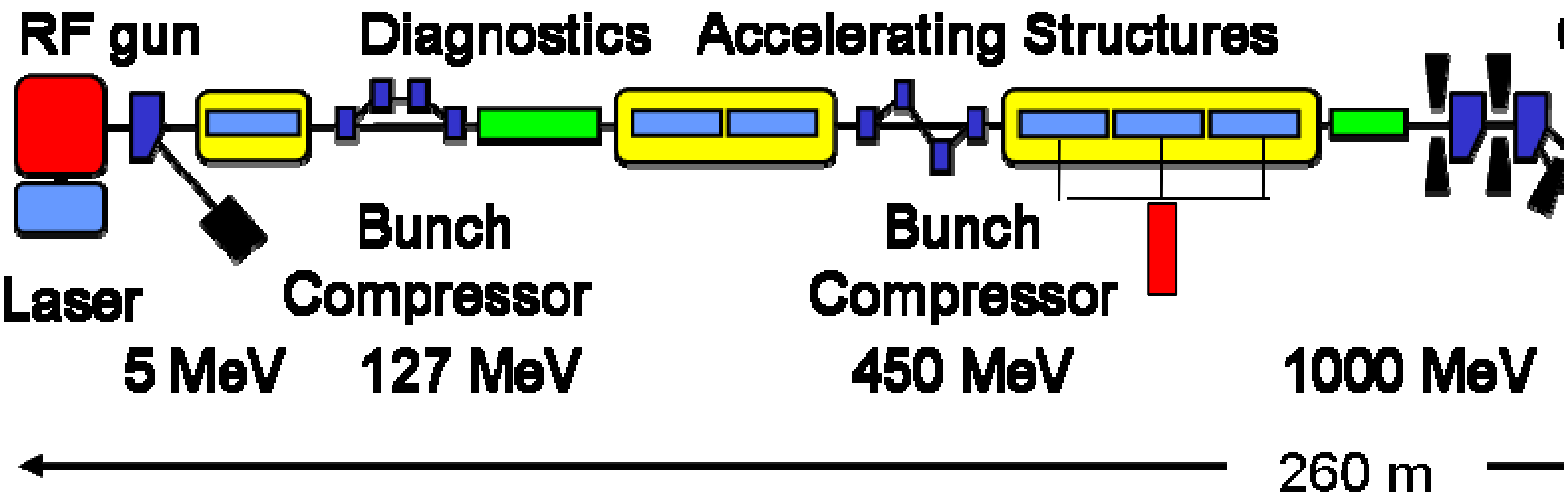
Beam Tests



		XFEL	ilc	FLASH design	FLASH experiment
Bunch charge	nC	1	3.2	1	3
# bunches		3250*	2625	7200*	2400
Pulse length	µs	650	970	800	800
Current	mA	5	9	9	9

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Accelerator Test Facility – ATF/ATF2

KEK Laboratory

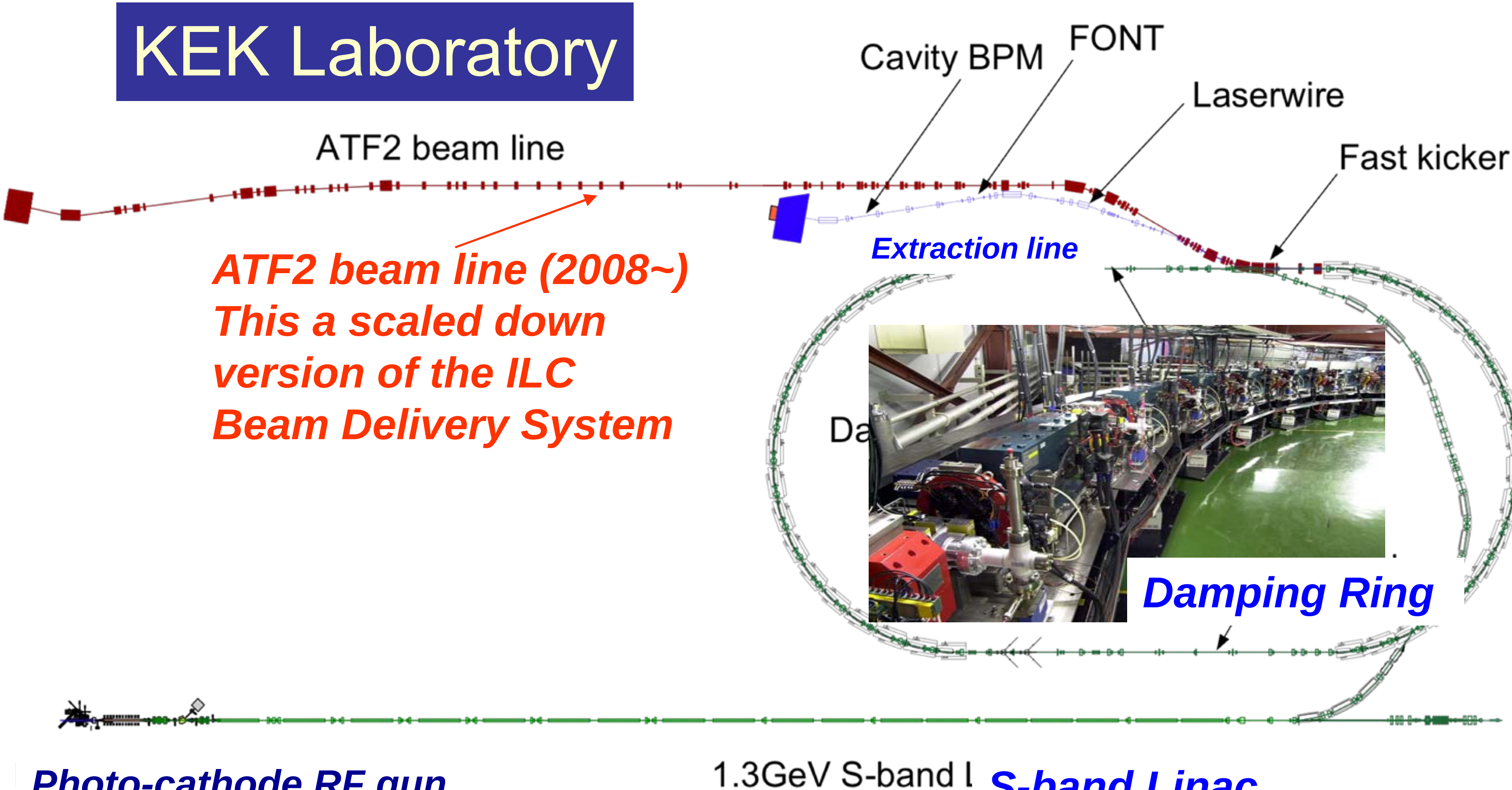

Photo-cathode RF gun
(electron source)

S-band Linac
Δf ECS for multi-bunch beam

ATF / ATF2 R&D Program and Goals

- Beam delivery system studies
  - **Demonstrate ~ 50 nm beam spot by 2010**
  - **Stabilize final focus by 2012**
- Broad international collaboration (mini-ILC) for equipment, commissioning and R&D program

ATF2 Beam Line vacuum pipe connected in October

Commissioning underway

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The ILC SCRF Cavity

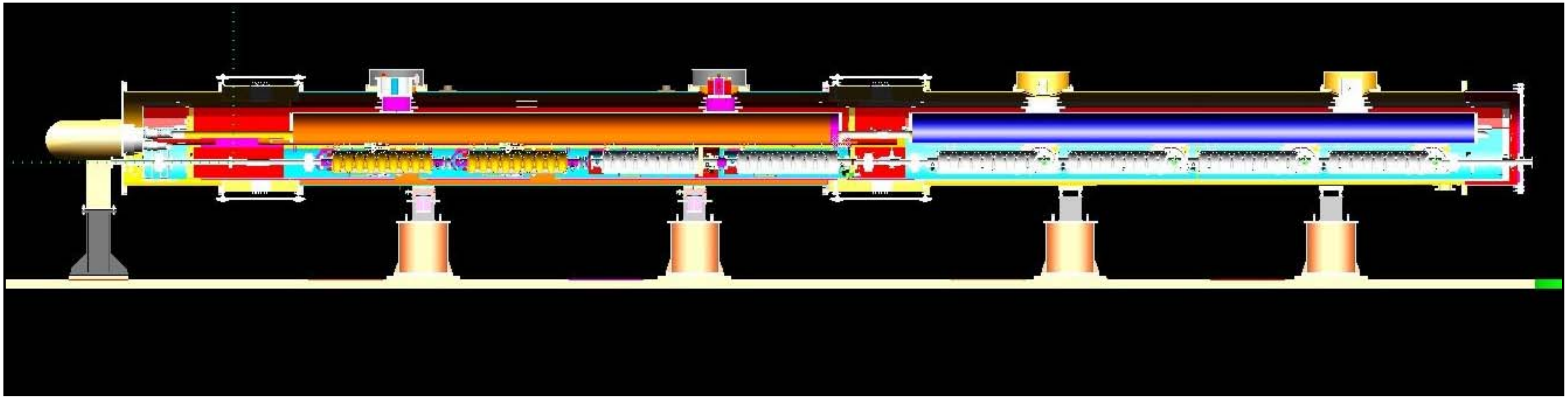
Figure 1.2-1: A TESLA nine-cell 1.3 GHz superconducting niobium cavity.

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

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

S1 Global Tests

- Cavity integration and the String Test globally organized with tests to be done at KEK STF facility
  - **2 cavities from DESY and Fermilab**
  - **4 cavities from KEK**
  - **Each half-cryomoducle from INFN and KEK**



Global R&D Plan
Consensus in SCRF-TA

Calender Year	2007	2008	2009	2010	2011	2012
Technical Design Phase	TDP-1				TDP-2	
Cavity Gradient R&D to reach 35 MV/m		Process Yield > 50%			Production Yield >90%	
Cavity-string test: with 1 cryomodule			Global collab. <31.5 MV/m>			
System Test with beam 1 RF-unit (3-modulce)		FLASH (DESY)			STF2 (KEK) NML (FNAL)	→ ?

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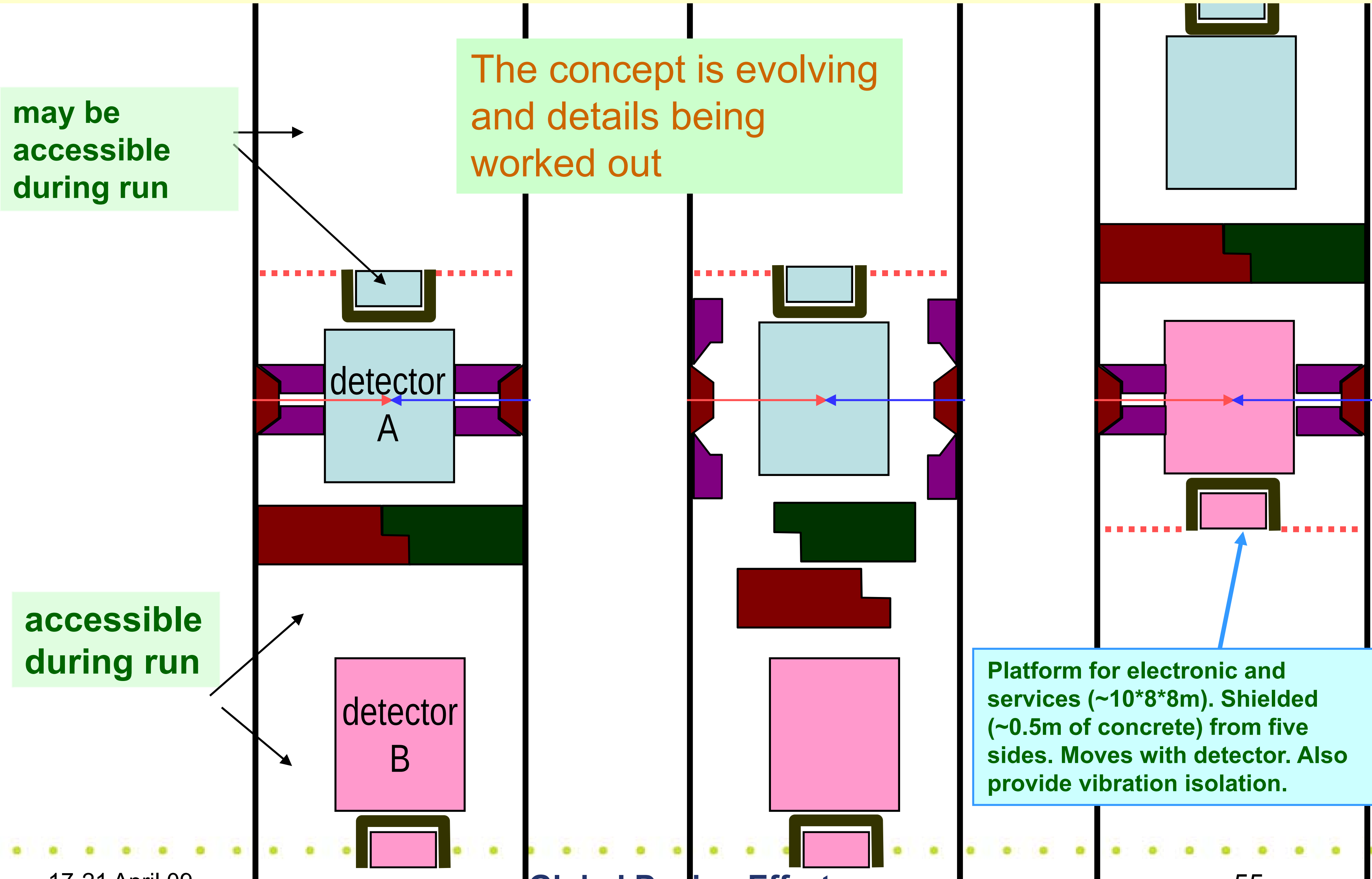
Accelerator Systems

- **Monday 20 April 2009**
- **AAP Review: Exec/AS - Room 201 (08:30-13:00)**
- time title presenter
- 08:30 AAP Executive Committee
- 09:30 Electron Source BRACHMANN, Axel
- 10:30 Positron Source CLARKE, Jim
- 11:00 Damping Rings GUIDUCCI, Susanna
- 11:30 RTML (Bunch Compressor) SOLYAK, Nikolay
- 12:00 BDS / MDI SERYI, Andrei
- 12:30 Simulation (beam dynamics) KUBO, Kiyoshi

Push-Pull Concept for two detectors



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from Paterson

"Minimum Machine" is code for

Design and Integration Studies in 2009 toward a Re-Baseline in 2010 which will be the basis of TDP2 Engineering Design and Costing

Minimum Machine is shorter

Ewan Paterson
GDE

Proposing the Updated Baseline from NJW

from Walker

- **Project Management will drive re-baseline design**
- **Core "design & integration" team**
  - TAG leaders
  - Cost Management Group
  - Few key (specialist) additions

  ~30 people
- **Series of face-to-face meetings foreseen**
  - **DESY 28-29.05**
  - **ALCPG GDE meeting (Albuquerque) 29.09-03.10**
  - **(Possible meeting in early December – tbc)**
- **Produce proposed baseline early 2010**
  - Review process → consensus → sign-off
- **Mechanisms for transparency and communication during process needs to be defined**
  - Particularly true for Physics & Detector groups

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Outline

from Walker

- TD Phase 1 & 2: The R&D Plan (recap)
- Scope of the Technical Design Report (TDP-2)
- Preparing for the ILC Baseline Review (TDP-1)
- Critical R&D Status in 2012 (TDP-1 & -2)
- Global Resources for TDP-2
- **Identified Management Issues**
  - (“Gorillas” and “Elephants”)

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Final Remarks

- The AAP is a new concept – a high level "internal" committee to monitor and review the technical and management aspects of our program
- This is a first meeting, but we expect it will set out the course of the AAP job for the next ~ 3-4 yrs.
- THANKYOU in advance! We will do all we can to make this process a success.