Cornell University
Laboratory for Elementary-Particle Physics

Integration into ILC-GDE

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Cornell Laboratory for

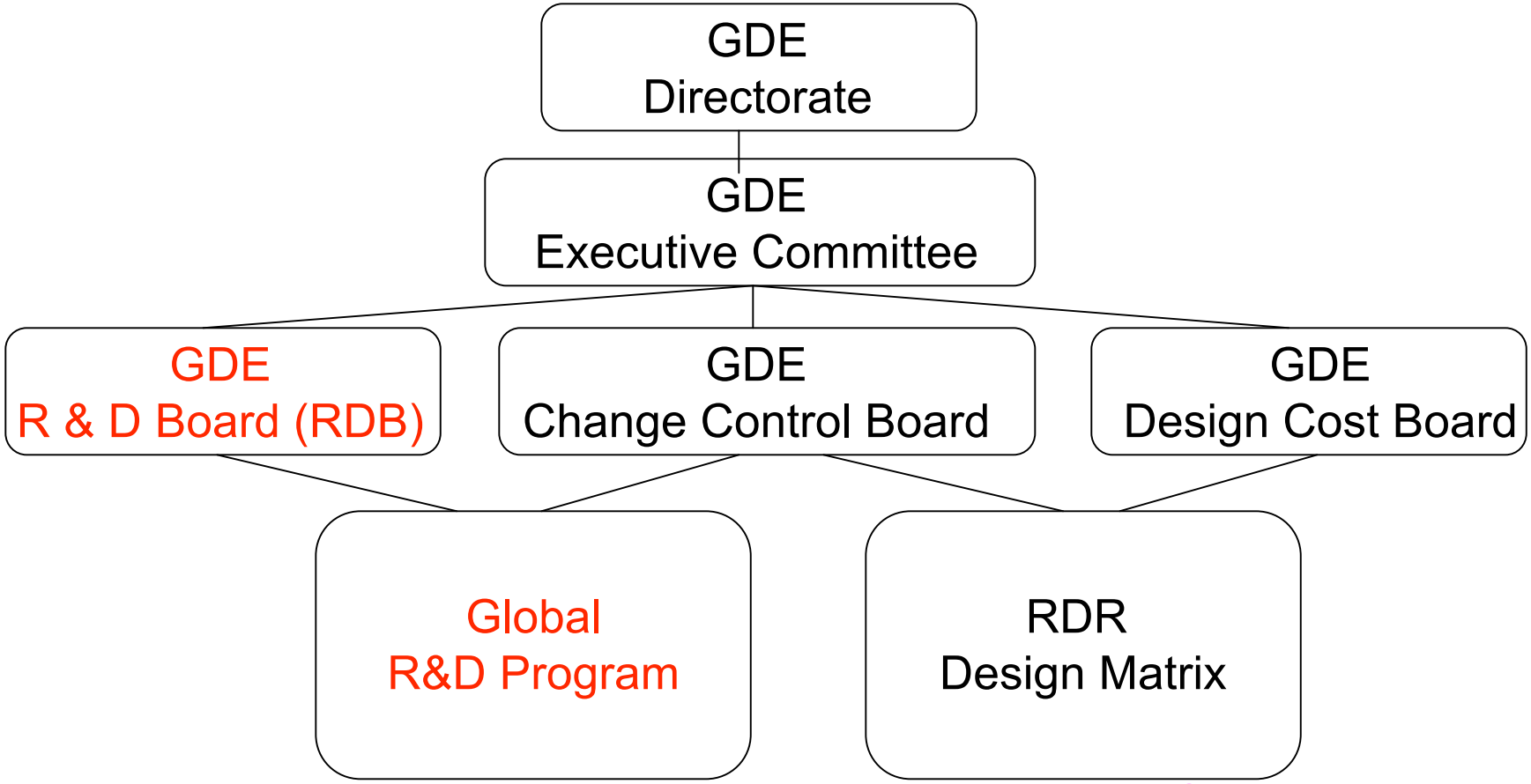
Accelerator-Based Sciences and Education

GDE – Mission Statement

- Produce a design for the ILC that includes a detailed design concept, performance assessments, reliable international costing, an industrialization plan , siting analysis, as well as detector concepts and scope.
- Coordinate worldwide prioritized proposal driven R&D efforts (to demonstrate and improve the performance, reduce the costs, attain the required reliability, etc.)

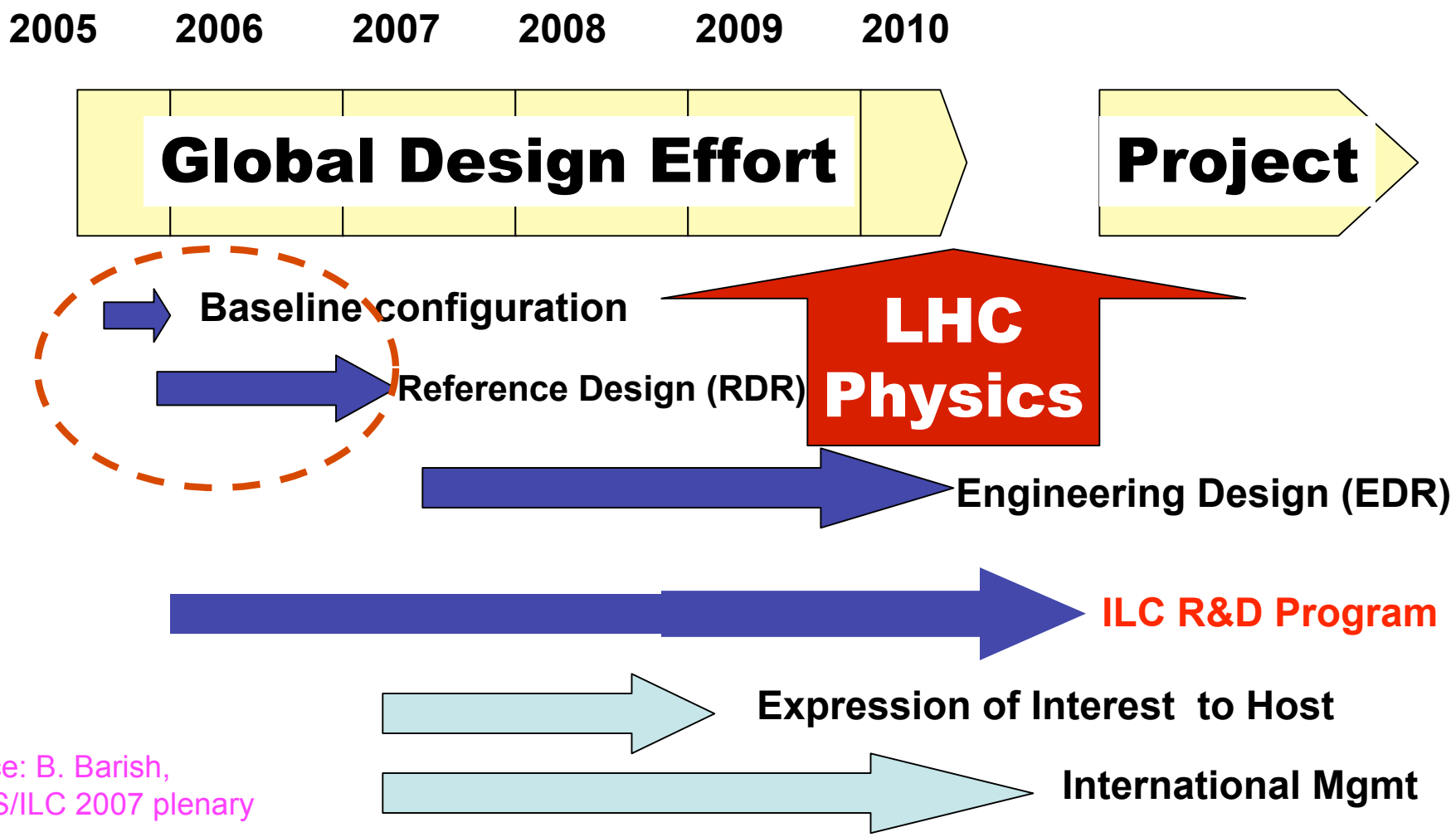
Source: B. Barish, LCWS/ILC 2007 plenary

GDE RDR / R&D Organization



Source: B. Barish,
LCWS/ILC 2007 plenary

ILC – Global Design Phase Schedule



Source: B. Barish,
LCWS/ILC 2007 plenary

Supporting R&D Program in the design phase

- Organized around task forces to achieve milestones linked to EDR schedule
- S0 task force - globally coordinated program to demonstrate gradient for EDR by 2009
- S2 task force – RF unit test and string tests by construction
- S3 task force – Electron Cloud tests to establish mitigation and verify one damping ring is sufficient

Source: B. Barish,
LCWS/ILC 2007 plenary

S3 Charge

The role of the S3 Task Force is to:

- advise the RDB on the research and development program for the ILC damping rings;
- support the coordination of specific parts of the damping rings research and development program.

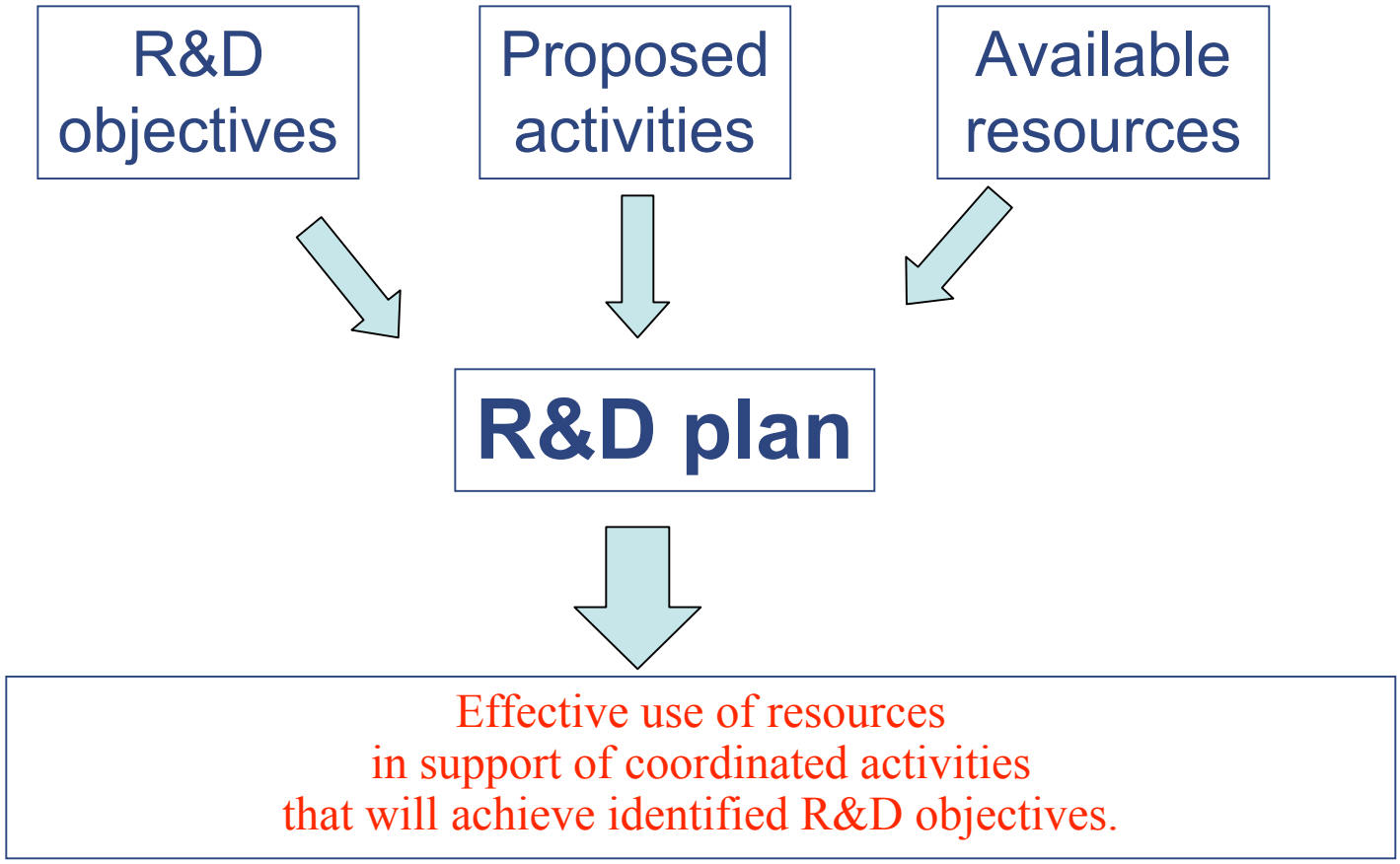
In its advisory role, the Task Force should draw up a coordinated R&D plan for the ILC damping rings, which the Task Force will recommend to the RDB…

S3 Membership

- Eckhard Elsen (DESY)
- Jie Gao (IHEP)
- Susanna Guiducci (INFN)
- Tom Mattison (UBC)
- Mark Palmer (Cornell)
- Mauro Pivi (SLAC)
- Junji Urakawa (KEK)
- Marco Venturini (LBNL)
- Andy Wolski (Cockroft Institute)
- Mike Zisman (LBNL)

Source: A. Wolski, Presentation to ILC MAC, 4/07

R&D Plan is our key "deliverable"



Source: A. Wolski, Presentation to ILC MAC, 4/07

S3 R&D Plan

- 11 Very High Priority Objectives
- 28 High Priority Objectives
- 31 Moderate Priority Objectives
- 6 Low Priority Objectives

Source: A. Wolski, Presentation to ILC MAC, 4/07

S3 R&D Plan

The 11 objectives identified as "Very High" priority divide into 6 Work Packages, with each Work Package encompassing those objectives grouped at the third level of the WBS.

WP 2.1.1	2.1.1.1	Lattice design for baseline positron ring
	2.1.1.2	Lattice design for baseline electron ring
WP 2.1.4	2.1.4.3	Demonstrate < 2 pm vertical emittance
WP 2.2.1	2.2.1.2	Characterize single bunch impedance-driven instabilities
WP 2.2.3	2.2.3.1	Characterize electron cloud build-up
	2.2.3.2	Develop electron cloud suppression techniques
	2.2.3.3	Develop modelling tools for electron cloud instabilities
	2.2.3.4	Determine electron cloud instability thresholds
WP 2.2.4	2.2.4.1	Characterize ion effects
	2.2.4.2	Specify techniques for suppressing ion effects
WP 3.5.1	3.5.1.1	Develop a fast high-power pulser

Source: A. Wolski, Presentation to ILC MAC, 4/07

S3 R&D Plan: low emittance tuning

S3 WBS	Objective	Priority
2.1.4.1	Develop strategies for low-emittance tuning	High
2.1.4.2	Specify requirements for survey, alignment and stabilization	High
2.1.4.3	Demonstrate < 2 pm vertical emittance	Very High
2.1.4.4	Specify support schemes for damping rings magnets	High
2.1.4.5	Specify orbit and coupling correction scheme	High

Achieving Objective 2.1.4.3 will require the following tasks:

- Evaluation of the availability of facilities (for example, ATF, CesrTA, APS, ALS etc.), and their capability to meet the requirements of low-emittance tuning techniques.
- Upgrade to diagnostics and instrumentation and orbit and coupling correction systems, where necessary.
- Implementation of low-emittance tuning techniques, and evaluation of the results (and implications for the damping rings).

Facilities

Experimental studies at CesrTA, ATF, ALS and APS are required to complete Objectives 2.1.4.1, 2.1.4.2 and 2.1.4.3. Results from these studies are also required for Objectives 2.1.4.4 and 2.1.4.5.

Source: S3 R&D plan

S3 R&D Plan: Electron Cloud

S3 WBS	Objective	Priority
2.2.3.1	Characterize electron-cloud build-up	Very High
2.2.3.2	Develop electron-cloud suppression techniques	Very High
2.2.3.3	Develop modelling tools for electron-cloud instabilities	Very High
2.2.3.4	Determine electron-cloud instability thresholds	Very High

Achieving the objective of characterizing the electron cloud build-up will involve the following tasks:

1. Perform experimental measurements of electron cloud build-up in wiggler sections in CesrTA, and benchmark simulation results against the data collected.

2. Continue effort to measure electron cloud in CesrTA, PEP-II, KEKB, DAΦNE and LHC, and benchmark codes against the data collected.

3….

Source: S3 R&D plan

S3 R&D Plan: Electron Cloud

Achieving the objective of developing suppression techniques for the electron cloud will involve the following tasks:

- 1. Study coating techniques, test the conditioning of coated surfaces and characterize their performance *in situ* in CesrTA, PEP-II and KEKB.
- 2. Test clearing electrode concepts by installing chambers with clearing electrodes in existing machines and in magnetic field regions in CesrTA, PEP-II, KEKB, LHC and HCX (LBNL). Characterize the impedance seen by the beam, the generation of higher order modes (HOMs), and the power deposited in the electrodes.
- 3. Test "groove" concepts by installing chambers with grooved or finned surfaces in existing machines, including bend and wiggler sections in CesrTA and PEP-II. Characterize the impedance and HOMs.

Facilities

CesrTA would provide a unique facility for studies of electron cloud under a range of conditions close to those expected in the damping rings. In particular, CesrTA would allow detailed studies of electron cloud build-up in wigglers (Objective 2.2.3.1) and tests of a range of mitigation techniques (Objective 2.2.3.2). Experimental data from several machines (CesrTA, PEP-II, KEKB, DAFNE, LHC) will be needed for proper completion of all the Objectives. Tests of grooved chambers for suppression of electron cloud are underway in PEP-II. It is possible that the KEKB positron ring could be tuned for low natural emittance (1 nm by reducing the energy from 3.5 GeV to 2.3 GeV), and some time could be available over the next few years for dedicated electron cloud studies.

Source: S3 R&D plan

S3 R&D Plan: Ion effects

S3 WBS	Objective	Priority
2.2.4.1	Characterize ion effects	Very High
2.2.3.2	Specify techniques for suppressing ion effects	Very High

Achieving the Objectives will involve the following tasks:

- Validate existing theoretical models and simulation tools for the fast ion instability by carrying out suitable measurements in available storage rings.
- Refine existing simulation tools beyond their current state or develop new tools if necessary to achieve acceptable agreement with the experiments.
- Demonstrate the existence of viable machine designs capable of meeting the specifications for beam quality and stability, and show experimental feasibility of these designs using existing machines if possible.
- Explore the effectiveness of a variety of mitigation techniques (such as clearing electrodes), if necessary.

Facilities

Experimental data from several machines (including CesrTA, KEK-ATF) will be needed for proper completion of all the Objectives.

Source: S3 R&D plan

Recommendation of the GDE R&D Board

The decision to give up one of the damping rings was based on the supposition that an intense R&D program on the beam instabilities would be performed in a suitable existing accelerator, soon enough to give confidence in the present Baseline within the time frame that would allow the return to the original design, should the attempts to find methods for mitigation of these effects fail.

- **Is this program required for the success of the ILC?**
  - The RDB has reviewed that once more, with outside expert advice, and we were able to reach a unanimous conclusion that the RDB agrees with the S3 position: the ILC Baseline is too risky without such an R&D program.
- **Will CesrTA provide the information to proceed with the ILC on the present Damping Ring design?**
  - The studies made and documented by the S3 Task Force are extensive and their primary conclusion is supported by experts in the field: the CesrTA program should allow the ILC to be built with confidence.

Source: Use of ILC Damping Ring Test Facilities: Recommendation of the GDE R&D Board (7/9/07)

Conclusion

- The GDE S3 Task Force has developed an internationally-coordinated plan for damping ring R&D in the ILC EDR phase, which has been ratified by the GDE Global R&D Board.
- This plan manages the technical risk in the current baseline design by focusing available resources on key very-high priority R&D objectives, such as the mitigation of the electron cloud effect.
- The experimental program made possible by the CESR-TA proposal addresses 7 of the 11 very-high priority R&D objectives, on a time scale commensurate with that required for the development of the EDR.
- The CESR-TA proposal is fully integrated into the ILC-GDE R&D program, and in fact it plays a critically important role in that program.
- If CESR-TA is not funded, it is not clear whether other facilities could adequately substitute for the CESR-TA capabilities on the required time scale. There would be a significant negative impact on the ILC-GDE R&D program.