



ILC GDE RDB S3: Damping Rings R&D Coordination

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GDE



S3 Charge

- The role of the Task Force S3 is to:
 - **advise the GDE Global R&D Board (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 research and development plan for the ILC damping rings, which the Task Force will recommend to the RDB.
- In its coordination role, the Task Force should facilitate communication between those involved in particular aspects of the damping rings R&D program.



S3 Membership & Responsibilities

- Eckhard Elsen (DESY)
- Jie Gao (IHEP)
- Susanna Guiducci (INFN-LNF)
 - **Bunch-by-bunch feedback systems**
- Tom Mattison (UBC)
 - **Kickers**
- Mark Palmer (Cornell)
 - **Magnets; RF system; Instrumentation and diagnostics; Supports & alignments**
- Mauro Pivi (SLAC)
 - **Multi-particle dynamics**
- Junji Urakawa (KEK)
 - **Instrumentation and diagnostics**
- Marco Venturini (SLAC)
 - **Multi-particle dynamics**
- Andy Wolski (Univ. Liverpool/Cockcroft Inst.); Chair
- Mike Zisman (LBNL)
 - **Single-particle dynamics; Supports and alignment; Systems integration**

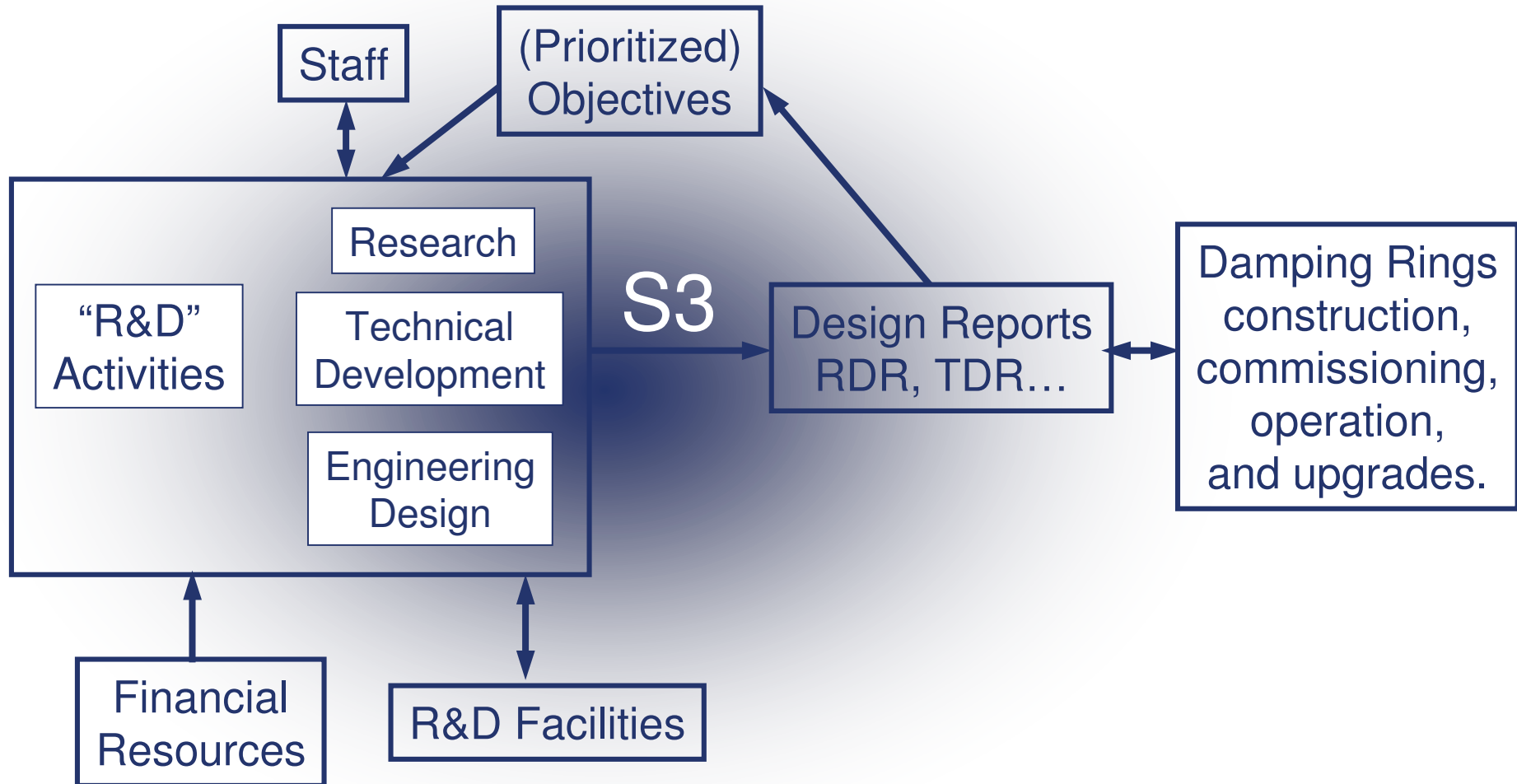


Present Status

- Review of priorities for research and development objectives.
- Compilation of research and developments activities and resources.
- First steps towards a damping rings R&D Plan.
- First steps towards communication and coordination.



Planning and Coordination Role of S3





Very High Priority R&D Objectives

- 2.1.1.1 Lattice design for baseline positron ring
- 2.1.1.2 Lattice design for baseline electron ring
- 2.1.4.3 Demonstrate < 2 pm vertical emittance
- 2.2.1.2 Characterize single-bunch impedance-driven instabilities
- 2.2.3.1 Characterize electron-cloud build-up
- 2.2.3.2 Develop electron-cloud suppression techniques
- 2.2.3.3 Develop modeling tools for electron-cloud instabilities
- 2.2.3.4 Determine electron-cloud instability thresholds
- 2.2.4.1 Characterize ion effects
- 2.2.4.2 Specify techniques for suppressing ion effects
- 3.5.1.1 Develop fast high-power pulser for injection/extraction kickers



High Priority R&D Objectives (1)

- 2.1.1.5 Lattice design for injection/extraction lines
- 2.1.1.6 Optics designs for injection/extraction sections in damping rings
- 2.1.2.1 Characterize damping rings acceptance
- 2.1.2.2 Optimize the damping rings acceptance
- 2.1.2.3 Specify magnet field quality required to ensure good acceptance
- 2.1.4.1 Develop strategies for low-emittance tuning
- 2.1.4.2 Specify requirements for survey, alignment and stabilization
- 2.1.4.4 Specify support schemes for damping rings magnets
- 2.1.4.5 Specify orbit and coupling correction scheme
- 2.2.1.1 Develop single-bunch impedance models
- 2.2.2.1 Develop long-range wakefield models
- 2.2.2.2 Characterize multi-bunch instabilities
- 2.2.2.3 Characterize the effects of injection transients



High Priority R&D Objectives (2)

- 3.1.1.1 Specify vacuum chamber material and geometry
- 3.1.1.2 Develop technical designs for principal vacuum chamber components
- 3.1.1.3 Characterize vacuum system performance
- 3.4.6.2 Develop engineering designs for damping wigglers
- 3.5.1.2 Develop physics designs for kicker striplines
- 3.6.1.1 Specify 650 MHz RF system
- 3.6.1.2 Prototype complete 650 MHz RF unit and test at high power
- 3.6.2.1 Develop conceptual design for 650 MHz RF cavities, cryomodules and supporting hardware
- 3.6.2.2 Develop engineering design for 650 MHz RF cavities, cryomodules and supporting hardware
- 3.6.4.1 Develop RF controls



High Priority R&D Objectives (3)

3.7.2.2 Develop feedforward for extraction kicker stabilization

3.7.3.4 Develop instrumentation for monitoring emittance damping

3.7.6.1 Specify overall requirements for instrumentation and diagnostics

3.10.1.2 Specify support and stabilization hardware

3.13.1.1 Develop integrated mechanical design



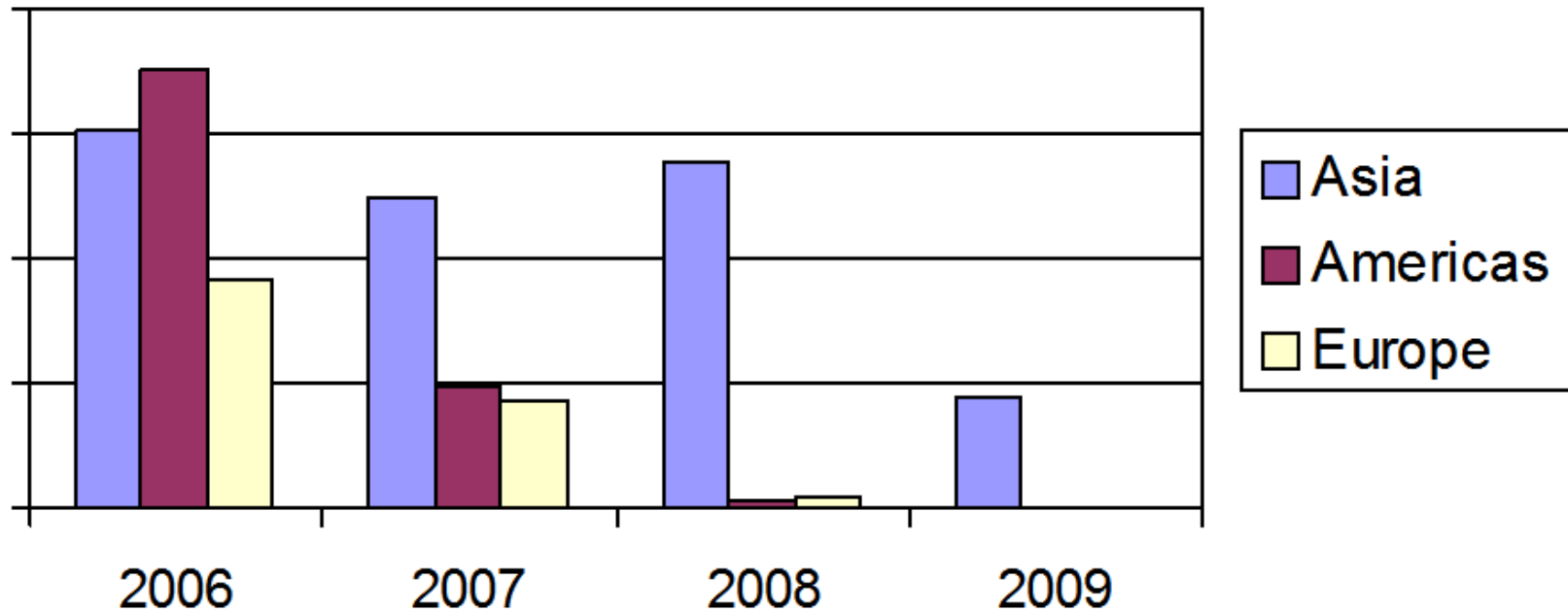
Resources for Present and Proposed Activities

- Damping Rings R&D Activities are compiled in a database.
 - An “Activity” is defined as a group of named researchers, collaborating on studies towards a stated objective.
 - Database presently includes **111 separate Activities** (either in progress or proposed), involving **162 named researchers** from **28 different institutions**.
- Each Activity is cross-referenced to one or more R&D Objectives.
 - An “Objective” is defined as a specific goal that must be achieved if the design, construction, commissioning and operation of the damping rings are to be completed successfully.
- Information on the resources has been collected for the various Activities.
 - Resource information includes level of effort (FTEs), costs of materials and services (M&S), and travel costs, for funding years 2006 - 2009.
 - Resources are categorised as “Approved”, “Proposed” or “Desired”.
 - Resources information is available for **90% of Activities**.



Resources for Present and Proposed Activities

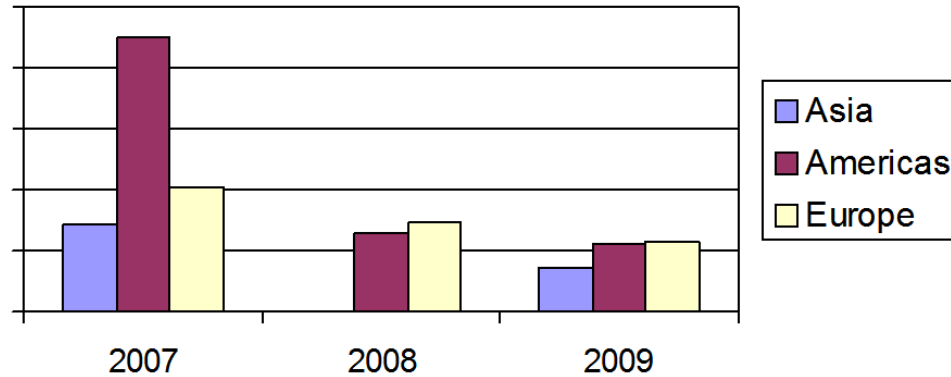
Total Approved FTE



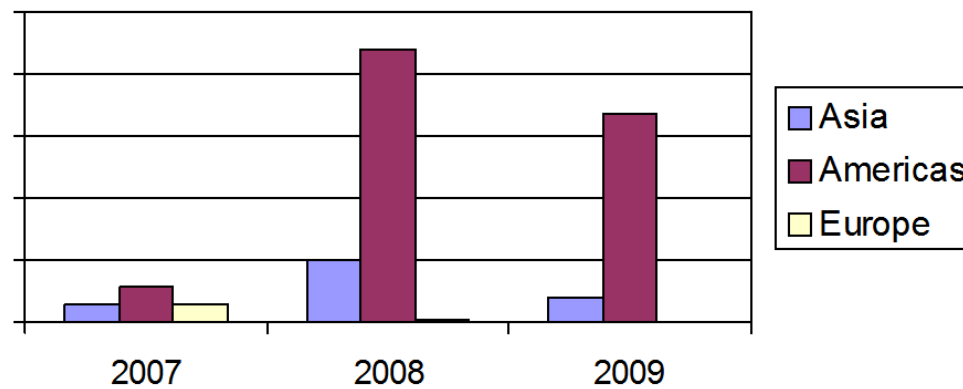


Resources for Present and Proposed Activities

Total Proposed FTE



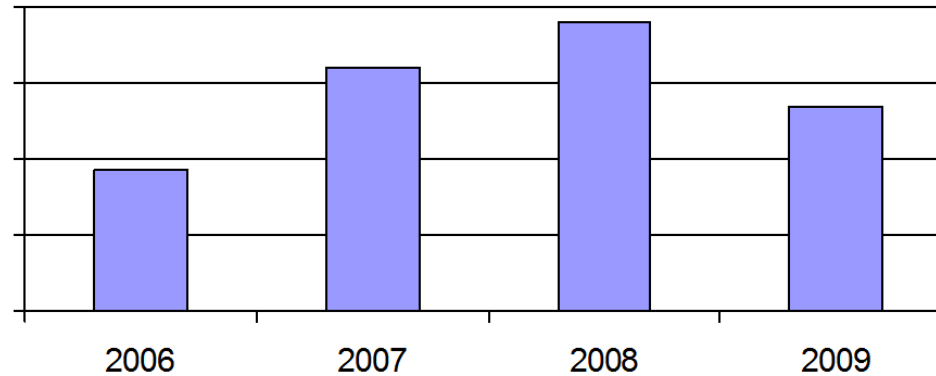
Total Desired FTE



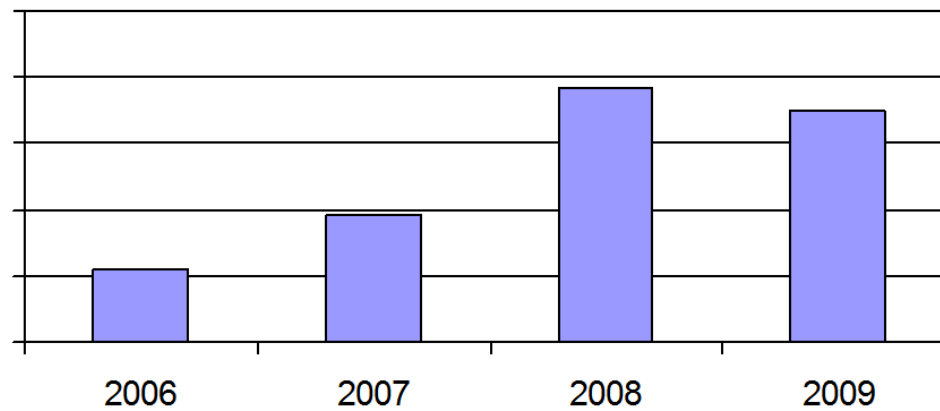


Resources for Present and Proposed Activities

Total Approved + Proposed + Desired FTE



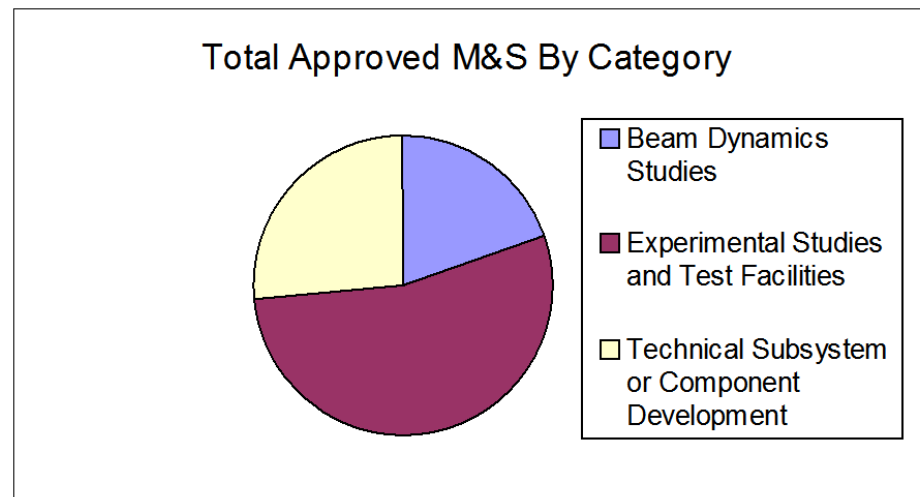
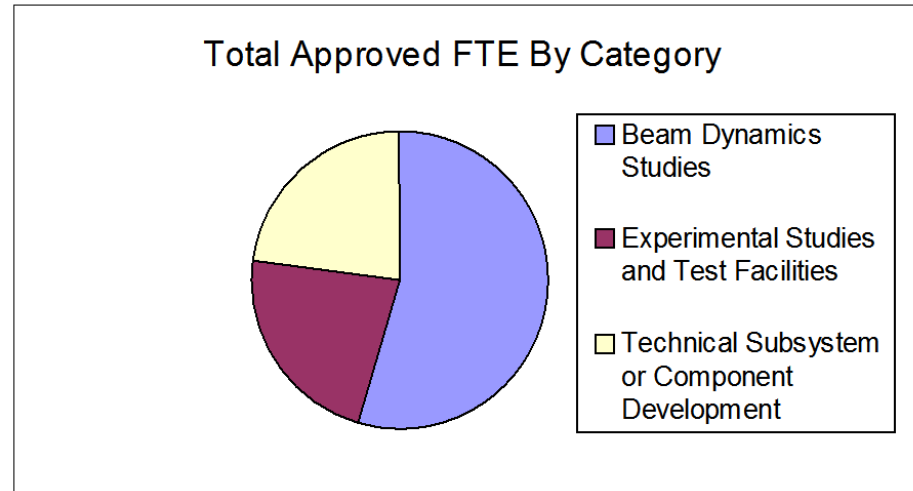
Total Approved + Proposed + Desired M&S (US\$k)





Resources for Present and Proposed Activities

Funding Year: 2007





Resources for Present and Proposed Activities

- Some important comments:
- The resource levels shown on the previous slides represent a “bottom-up” estimate, based on individual R&D plans developed at separate laboratories.
- There is some duplication of effort in the proposals. First indications are that there are not many gaps (but we will likely identify more as we progress with developing the R&D plan).
- The resource levels compiled for the database should be taken as nothing more than a very rough indication of the level of resources needed to accomplish a coordinated R&D plan.
- The aim is to use the indicated resource levels in guiding the development of a realistic, properly coordinated R&D plan, evolved from the present R&D Activities.
- Not all proposals are included, *e.g. HERA-DR is presently omitted.*



Developing a Coordinated R&D Plan

- At this Workshop, the members of S3 discussed and agreed on a “template” for a document that will detail R&D Plan.
- The R&D Plan will be structured in Work Packages. For each Work Package, the R&D Plan document will specify or include:
 - A named Work Package Coordinator.
 - A list of named Investigators.
 - A summary table of Approved or Proposed resources (broken down as appropriate by type of activity - e.g. simulation, or experimental - and by region).
 - A list of R&D Objectives.



Developing a Coordinated R&D Plan

Each Objective in the R&D Plan Document will specify or include:

- A named coordinator (as appropriate).
- A short summary of present R&D status and why the R&D is needed.
- A list of specific tasks to be undertaken towards achieving the Objective.
- A list of named Investigators, who will perform the tasks.
- Resources required to complete the tasks (including effort and M&S).
- Deadlines for completing the tasks (and hence for completing the Objective).
- Required input (cross-referenced to other R&D Objectives or tasks).
- Deliverables (cross-referenced to other R&D Objectives or tasks).



Developing a Coordinated R&D Plan

The R&D Plan document will provide a reference for anyone interested in damping rings R&D.

The R&D Plan document will state clearly:

- **the activities that are required and why they are needed;**
- **who is carrying out each of the various activities;**
- **the resources (and inputs) that are needed to complete the R&D Objectives;**
- **the deliverables and the deadlines.**



Developing a Coordinated R&D Plan

- Responsibility for the development of the R&D Plan will be shared between the members of S3, in accordance with the specialties already identified.
 - **Those involved in Damping Rings R&D Activities must be fully involved in development of the R&D Plan.**
- The descriptions of those Work Packages containing Very High Priority R&D Objectives will be addressed first.
 - **Work Packages will generally correspond to items at the third level of the R&D WBS (e.g. “Electron Cloud”), but there is flexibility in this.**



R&D Plan: An Example

Work Package 2.1.4: Low-Emittance Tuning

Work Package Coordinator: Mike Zisman

Investigators:

Yunhai Cai (SLAC)
Louis Emery (ANL)
Richard Helms (Cornell)
James Jones (CCLRC-ASTeC)
Mark Palmer (Comell)
Gregg Penn (LBNL)
Ina Reichel (LBNL)
Vadim Sajaev (ANL)
Maury Tigner (Cornell)
Marco Venturini (LBNL)
Andy Wolski (Liverpool/CI)
Aimin Xiao (ANL)
Mike Zisman (LBNL)

Approved/Proposed Resources Summary:

	Approved			Proposed		
	FTE	M&S	Travel	FTE	M&S	Travel
2006						
2007						
2008						
2009						



R&D Plan: An Example

Objective 2.1.4.1:

Develop strategies for low-emittance tuning. (High Priority)

Various techniques are in use to correct the sources of vertical emittance in storage rings; for example, orbit and dispersion coupling, followed by tuning of skew quadrupoles to minimize the vertical orbit change to horizontal steering. Such techniques have been used at the ATF to achieve a vertical emittance of 4.5 pm [1]. Orbit response matrix analysis has been used at the ALS [2] and at the ATF [3] with some success. However, none of the techniques so far tried has proven successful in achieving a vertical emittance of the ILC goal of 2 pm.

Achieving the objective of producing effective strategies for low-emittance tuning will involve the following tasks:

1. Performing studies to understand the limitations of existing techniques, and recommending improvements or optimizations.
2. Devising new tuning techniques.
3. Performing a thorough and systematic comparison of a range of low-emittance techniques, based on simulations on existing rings (e.g. the ATF and the ALS) and on the lattices for the ILC damping rings.



R&D Plan: An Example

Investigators on these tasks will be:

- Yunhai Cai (SLAC)
- Richard Helms (Cornell)
- James Jones (CCLRC-ASTeC)
- Ina Reichel (LBNL)
- Aimin Xiao (ANL)

A total effort of 1.0 FTE per year for two years will be required. Work is mainly simulation.

Work on these tasks should start immediately. The goal is to complete all three tasks by the end of 2008.

The required input includes:

- Data from previous low-emittance tuning studies (theoretical and experimental) at the ATF and the ALS.
- Lattice design for the ILC damping rings.

The deliverables will include:

- Recommended low-emittance tuning strategy or strategies, that are well-understood, and that can be tested experimentally (Objective 2.1.4.3).
- Guidance for further studies leading to specification of the alignment and stabilization requirements (Objective 2.1.4.2) and for the orbit and coupling correction scheme (Objective 2.1.4.5).



Developing a Coordinated R&D Plan

- The goal is to have drafts of the first Work Packages in place by the time of the ILC MAC meeting in January.
 - **Initial outlines for three Very High Priority topics (Electron Cloud; Impedance; Kickers) are already available from the Damping Rings Workshop held at Cornell at the end of September 2007.**
- As part of the process of drawing up the R&D Plan document, duplications in Activities will naturally be addressed...
 - **Resolving duplications of effort will involve negotiation between those involved in the duplicated activities, with negotiations led by the members of S3.**
- ...and gaps will be identified (and - we hope - filled).



Developing a Coordinated R&D Plan

- Completing, updating and maintaining the R&D Plan document will be an on-going process.
 - **We hope that a draft covering at least the Very High Priority R&D items will be available in Spring 2007.**
 - **Structures being put in place now should support the process of updating and maintaining the R&D Plan, if appropriate.**
- Many of the same people under pressure to work on the R&D Plan document are also under pressure to work on the RDR.



Role of large-scale experimental facilities

- There are several existing machines that are being used, or could be used, for damping rings R&D:
 - **KEK-ATF** : Already operating for several years, with a highly successful R&D program. Focus will shift towards ATF2 in future, but some damping rings studies are expected to continue.
 - **Light sources, B-factories...**
- There are two proposals for major developments of existing machines into new facilities:
 - **Cornell CESR-TA**: Proposal for development of a test facility, to prototype specific subsystems (such as the superconducting wigglers), and study beam dynamics issues (such as electron cloud effects, and low emittance tuning).
 - **DESY HERA-DR**: Proposal to develop HERA into one of the ILC damping rings, over a number of distinct stages, including demonstration of some of the most pressing accelerator physics issues.
- The potential role of each of the existing or proposed test facilities within the global damping rings R&D program needs to be carefully evaluated.



Role of large-scale experimental facilities

1. What is the proposed R&D program, and how does it address the R&D needs of the ILC?
 - **Justification for the test facility**
2. Are there other facilities that could be used to carry out each element of the program?
 - **Justification for THIS test facility**
3. What resources are needed to carry through the program?
 - **Cost / benefit of the proposed R&D**
4. What is the timescale of the research?
5. What are the risks involved?



Communicating and Coordinating DR R&D

- As with some other Area and Technical/Global Systems in ILC, the very wide distribution of effort over an extremely diverse range of R&D issues presents considerable challenges in coordination.
- Rather than a single regular Damping Rings meeting, the most practical way to proceed is with a set of regular meetings on specific topics.
- A regular WebEx meeting has been started for Electron Cloud and Impedance Effects.
 - **Coordinated by Mauro Pivi and Marco Venturini.**
 - **See the Damping Rings Wiki site (hosted and maintained by LEPP, Cornell).**
- Further meetings on other specific topics (e.g. kickers) will start soon.

S3 has:

- **completed a review of the priorities of Damping Rings R&D Objectives;**
- **completed the compilation of a list of present and proposed Damping Rings R&D Activities, including named Investigators, and required resources;**
- **agreed a template for a document detailing the Damping Rings R&D Plan, including deliverables, resources and deadlines**
- **commenced regular meetings to provide a means of communication between those working on specific Damping Rings R&D topics.**



Summary

S3 will:

- **by January 2007, complete the first drafts of the first Work Packages within the Damping Rings R&D Plan;**
- **by spring or early summer 2007, complete the descriptions of those Work Packages within the Damping Rings R&D Plan that contain Very High Priority R&D Objectives;**
- **resolve duplication of effort and gaps in the programme as a natural part of the development of the R&D Plan document;**
- **continue to support communication and coordination of R&D activities through WebEx meetings, and workshops (e.g. the ILCDR'06 Workshop at Cornell).**