

ILC Damping Rings R&D Meeting: Cornell, 26-28 September 2006

Andy Wolski

University of Liverpool and the Cockcroft Institute

26 September, 2006

The Cockcroft Institute
An International Centre for Research in
Accelerator Science and Technology



THE UNIVERSITY
of **LIVERPOOL**

Goals of this Workshop

This workshop will be focused on damping rings R&D for:

- development of fast injection/extraction kickers;
- understanding and mitigation of electron cloud effects;
- calculation and modeling of impedance and impedance-driven instabilities.

The goals of this workshop are to:

1. bring together those involved in R&D for the damping rings on the above topics;
2. review the present status and understanding of the above R&D topics through technical presentations and discussions;
3. lay out an R&D plan identifying tasks, schedule, people and resources, aimed at achieving the performance specifications for the damping rings on a timescale consistent with the design and construction of the machine.

Damping Rings R&D Context

We are presently completing the cost estimate for the RDR.

Cost estimate is based on the present baseline configuration.

The baseline configuration has undergone two changes in the past year, and further changes are on the way...

See the following slides for a summary.

We needed to estimate the cost of some items (for example, the injection/extraction kickers) for which we don't have full technical solutions.

The RDB has been collecting information on the R&D program.

A list of R&D objectives has been compiled, and priorities assigned.

A list of activities has been compiled, and cross-referenced to the objectives.

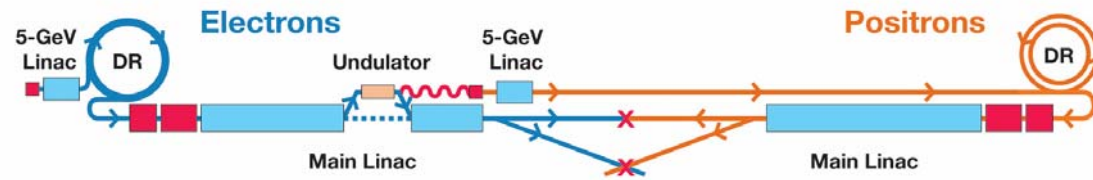
We are in the process of collecting information on the present resources, and resources required for the anticipated program.

See later slides for a summary.

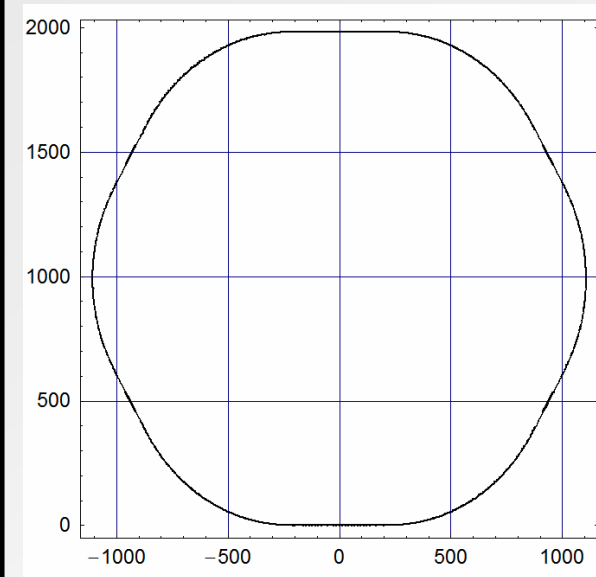
The RDB is setting up a Task Force (“S3”) to coordinate R&D for the Damping Rings.

See later slides for Charge and Membership.

Baseline Configuration, 26 September 2006



Beam energy	5 GeV
Circumference	6695 m
RF frequency	650 MHz
Harmonic number	14516
Injected (normalised) positron emittance	0.01 m
Extracted (normalised) emittance	8 $\mu\text{m} \times 20 \text{ nm}$
Extracted energy spread	<0.15%
Average current	400 mA
Maximum particles per bunch	2×10^{10}
Bunch length (rms)	6 mm
Minimum bunch separation	3.08 ns



DR Configuration Changes Through 2006

February 27, 2006: Damping Rings RF Frequency.

Proposed to change from 500 MHz to 650 MHz to allow operation of 6 km damping rings with low-Q parameter set (6000 bunches), and to ease technical difficulties of phase-locking between damping rings and main linac RF.

R&D required for 650 MHz RF system.

September 18, 2006: Elimination of one positron damping ring.

Proposed to use a single positron damping ring, instead of the original pair of damping rings intended to mitigate electron cloud effects.

Proposal was supported by recent studies of mitigation techniques (clearing electrodes, grooves, low-SEY coatings) presented and discussed at VLCW06.

Objective was to reduce costs, but also has the benefit of simplifying injection/extraction.

Approved, subject to continued R&D on electron-cloud mitigation. Possibility of later installation of second positron damping ring should be allowed.

In preparation: Co-location of e^- and e^+ rings in a single “central” tunnel.

Future possibility: Reduce circumference to 3 km.

Total number of bunches per bunch train would be reduced by half, and bunch spacing in linac would be doubled. Bunch charge would be unchanged.

GDE R&D Board: Damping Rings R&D Database



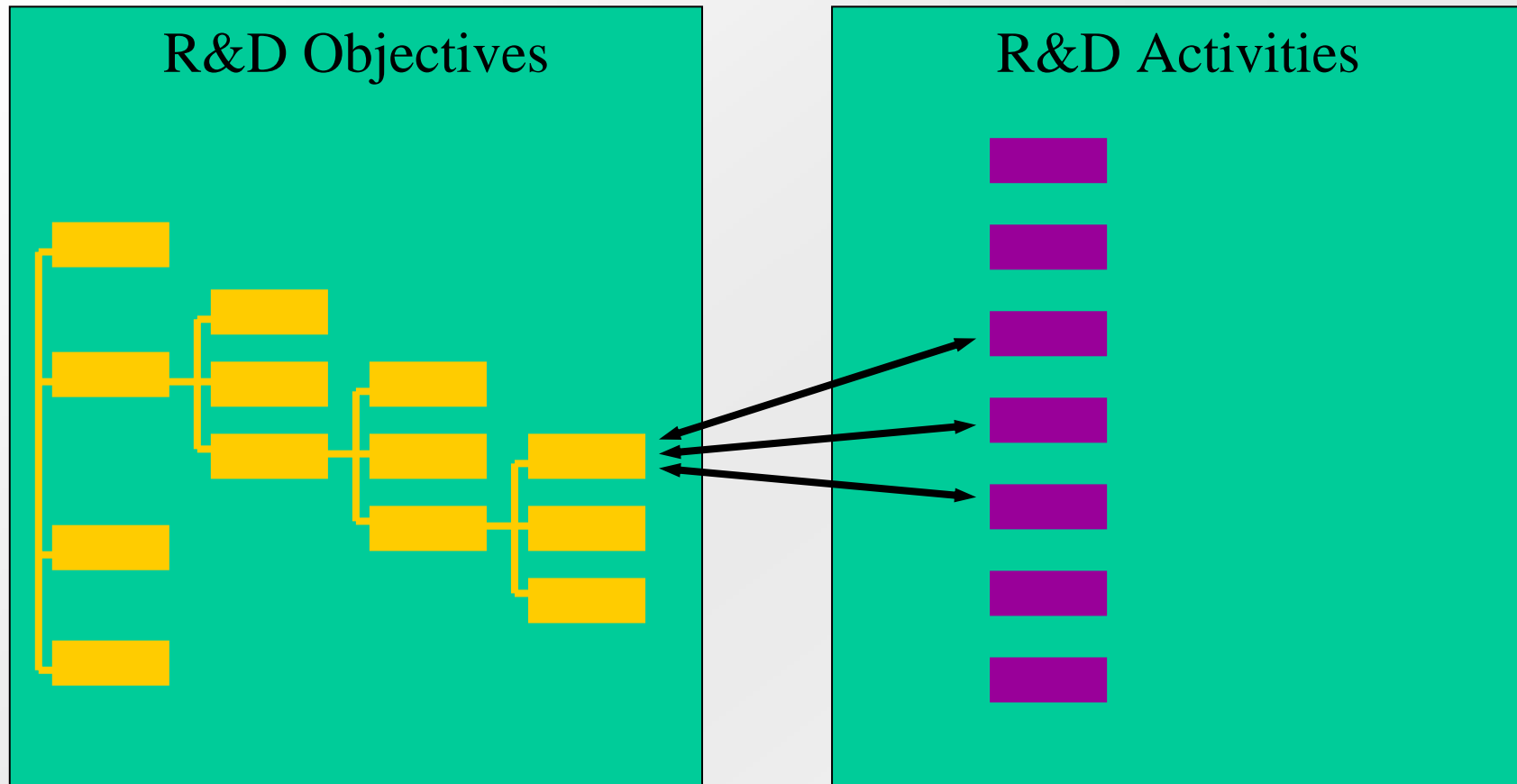
R&D Objectives are organised into a Work Breakdown Structure

GDE R&D Board: Damping Rings R&D Database



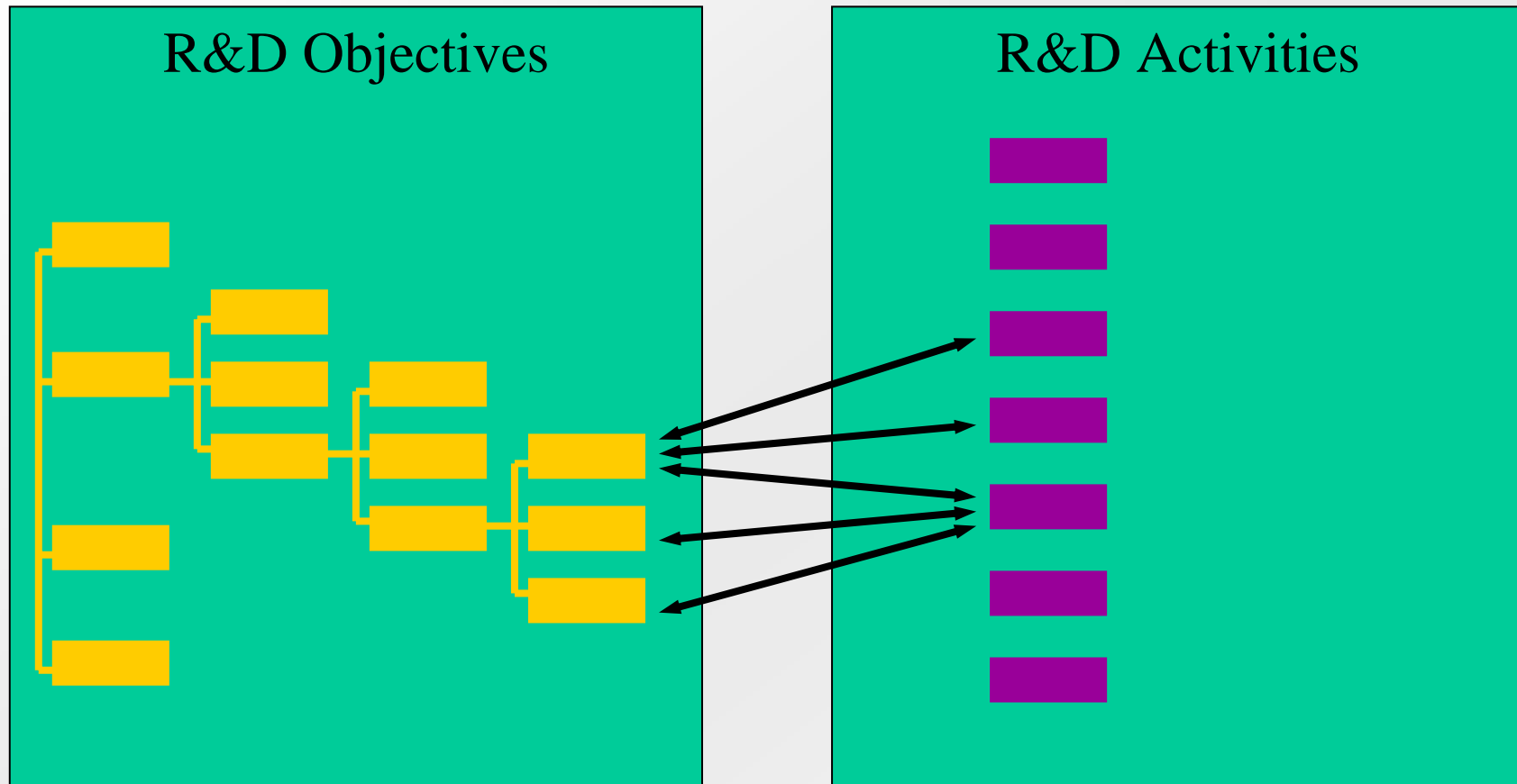
A list is compiled of different R&D activities

GDE R&D Board: Damping Rings R&D Database



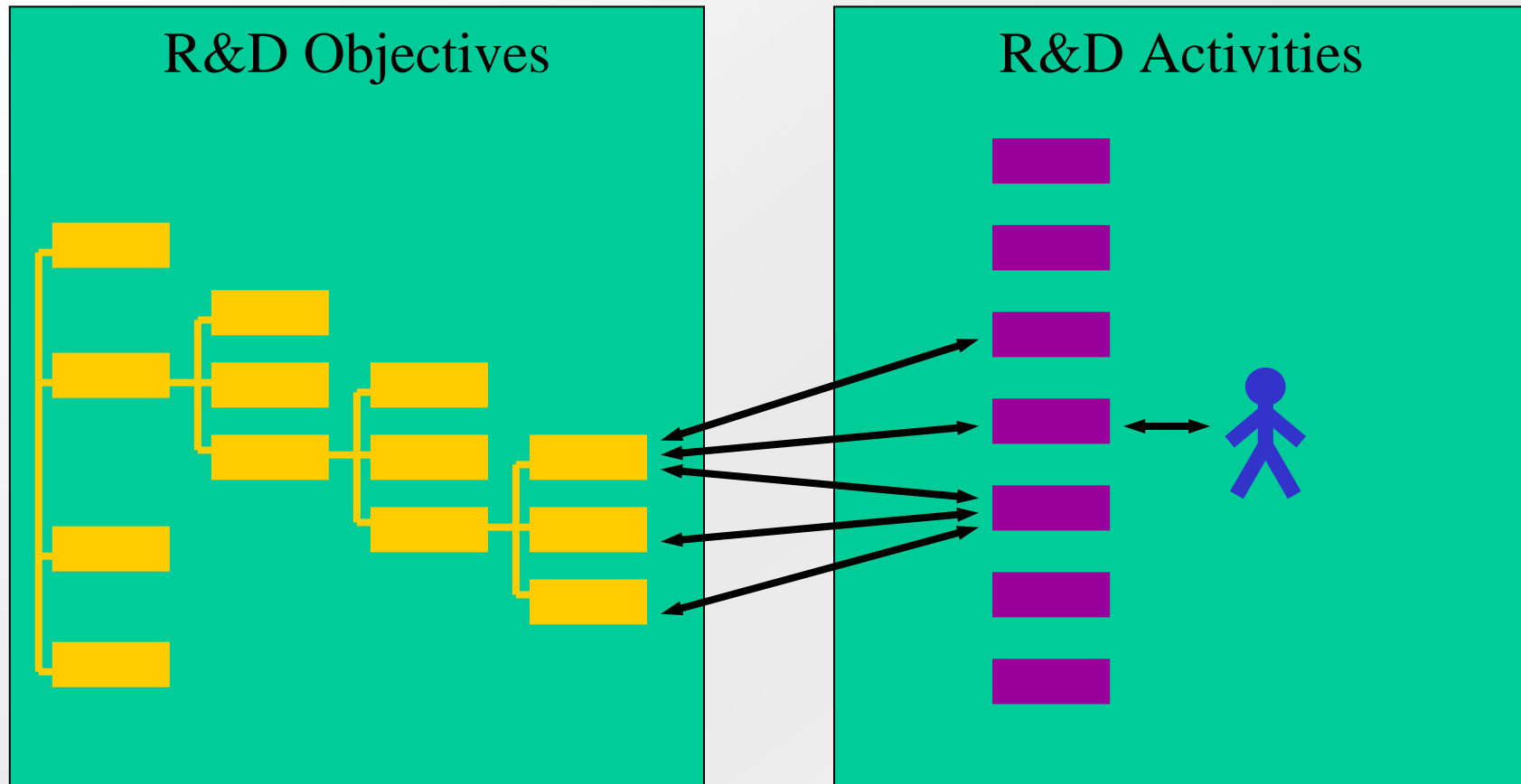
Each Objective can be linked to one or more Activity...

GDE R&D Board: Damping Rings R&D Database



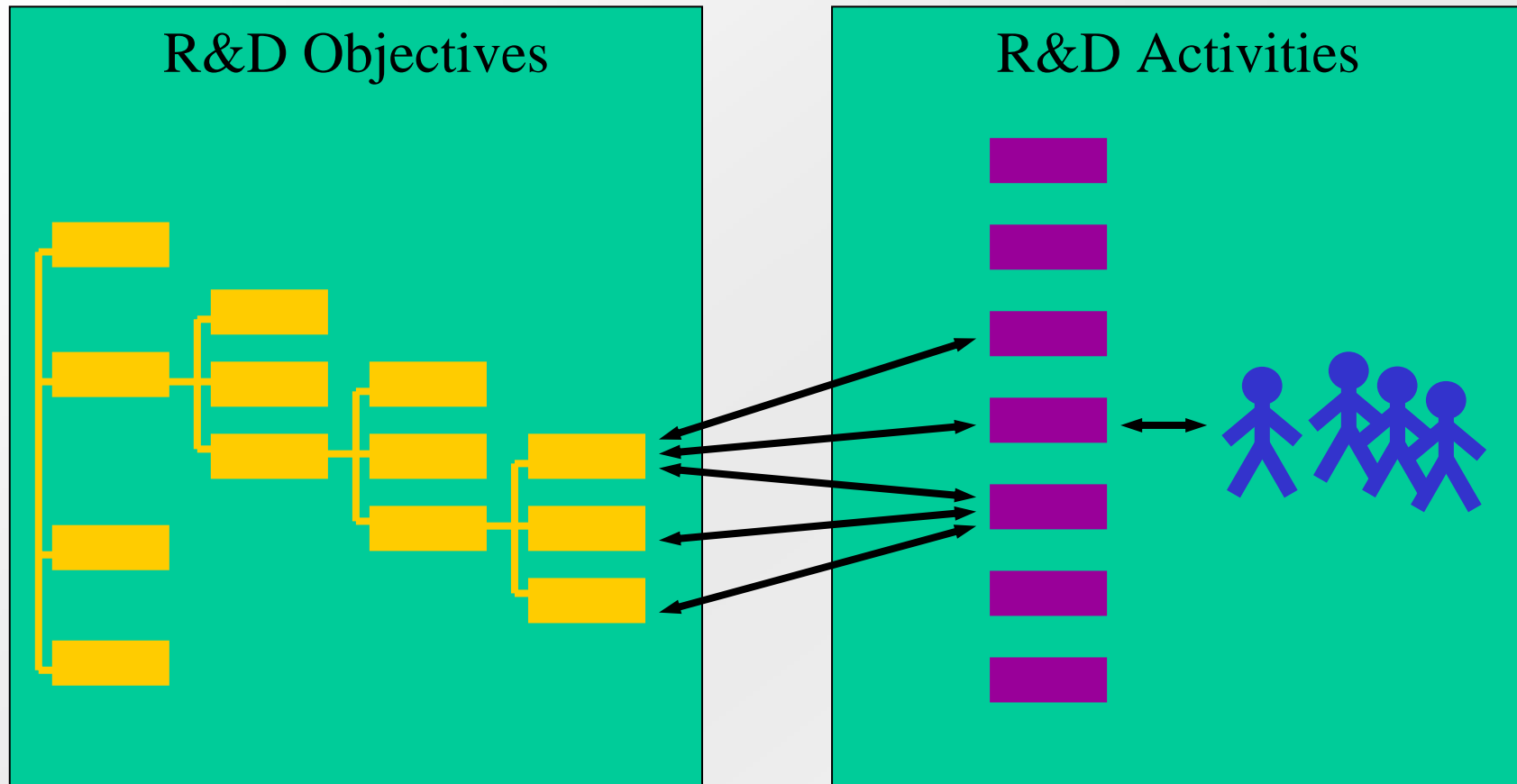
...and each Activity can be linked to one or more Objective.

GDE R&D Board: Damping Rings R&D Database



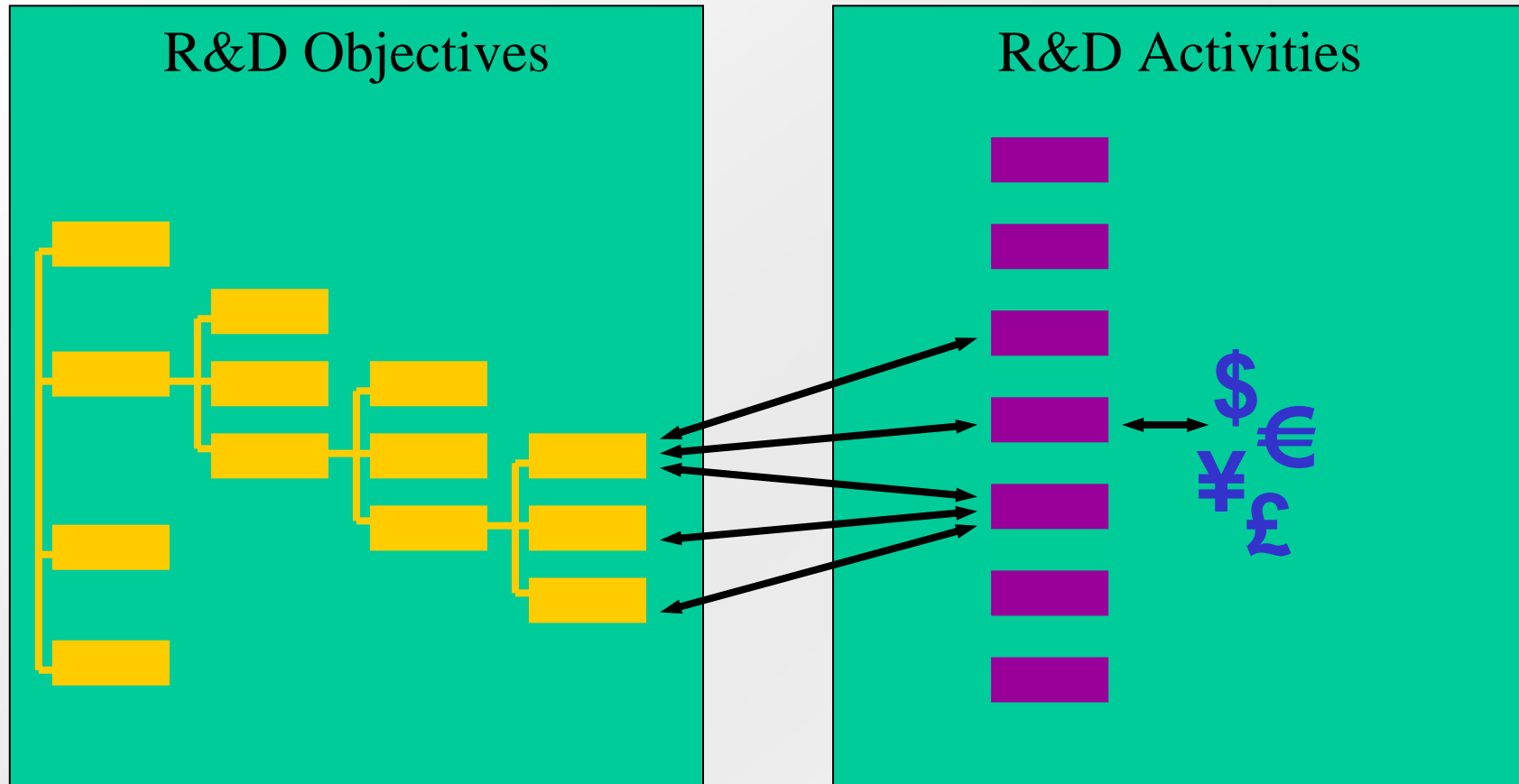
Each Activity has a single named Lead Investigator....

GDE R&D Board: Damping Rings R&D Database



...and a group of any number of named investigators from different labs.

GDE R&D Board: Damping Rings R&D Database



We are collecting information on the resources required for each activity.

GDE R&D Board: Damping Rings R&D Database

The Damping Rings R&D Database is designed to:

- allow the identification of gaps in the R&D program (objectives not covered by any activity);
- allow the identification of duplicated activities (multiple activities addressing the same objective);
- provide a central source of information on who is doing (or plans to do) what, to assist planning the future programme;
- allow estimates to be made of resources being used, and resources likely to be needed, to assist planning the future programme;
- support monitoring of the research and development status, by recording the current R&D activities and identifying a lead investigator for each activity.

Coordinating the Damping Rings R&D is a Challenge

Total number of activities: 108

45 currently in progress

Total number of named investigators: 148

60 named lead investigators

Total FTEs in 2006: approximately 20

Total number of institutions involved: 27

The three most “heavily subscribed” R&D topics...

The three most “heavily subscribed” topics account for nearly a third of all damping rings R&D activities:

Electron cloud

17 separate activities

38 named investigators

Impedance and impedance-driven instabilities

10 separate activities

16 named investigators

Injection/extraction kickers

8 separate activities

14 named investigators

These topics are also those identified by the R&D Board as those (together with ion effects) having **very high** priority.

The “S3” Task Force: Coordinating the Damping Rings R&D

“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.”

The “S3” Task Force: Coordinating the Damping Rings R&D

“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. This plan should consider:

- the specific research and development objectives, and their priorities;
- the resources available to support the R&D program;
- time scales for the research projects, in the context of the overall time scale for the ILC R&D and construction phases;
- the need for and availability of test facilities for specific aspects of the damping rings research and development program, and for damping rings system tests.”

The “S3” Task Force: Coordinating the Damping Rings R&D

“The coordinated research and development plan should address duplication of effort on particular R&D objectives, as well as gaps in the program. The plan should include specific research and development goals and milestones for the damping rings.

In its coordination role, the Task Force should facilitate communication between those involved in particular aspects of the damping rings R&D program e.g. by organizing telephone and video meetings, and workshops as appropriate. The Task Force should be responsible for communicating progress with the research and development program to the RDB.”

The “S3” Task Force: Coordinating the Damping Rings R&D

Membership of S3 (nominated by Global R&D Board and Damping Rings Area System Leaders):

Eckhard Elsen (DESY)

Jie Gao (IHEP)

Susanna Guiducci (INFN-LNF)

Tom Mattison (UBC)

Mark Palmer (Cornell)

Mauro Pivi (SLAC)

Junji Urakawa (KEK)

Marco Venturini (LBNL)

Andy Wolski (Liverpool/CI) - Chair

Mike Zisman (LBNL)

First meeting: Tuesday 26 September, 13:00 - 14:00

The Way Forward

The most urgent issue that needs to be addressed is the *apparent* duplication in effort - multiple activities addressing single objectives.

The funding agencies are already consulting the R&D Board regarding priorities. They are also asking about duplication.

So far, the R&D plans of separate institutions have been put together more-or-less independently.

The future R&D programme must be coordinated much more effectively.

The Way Forward

We should not talk about the R&D programmes of individual laboratories.

We should talk about the R&D programme for individual objectives, e.g. the kickers R&D programme, or the electron cloud R&D programme.

The S3 Task Force will play an *active* role in defining the R&D programme for the various objectives, integrating the contributions from various laboratories in a coordinated way.

Workshop Goals: Charge for the Working Groups

In the first two days:

Listen to the technical presentations.

Discuss the issues.

Think about a coordinated R&D plan involving all those willing and able to make a contribution.

During the discussion parallel sessions on Thursday morning:

Make a *first draft* of a coordinated R&D plan for your topic, including:

- goals and milestones;
- clearly-stated roles and responsibilities (names of *individuals* preferred if possible - but it's ok to give named *institutions*, as long as there is a named "local coordinator").

Presenting the S3 Task Force with an initial draft for a coordinated plan, drawn up by those involved, will ease the process and make a satisfactory outcome more likely.

Finally...

Thank you all for coming, and for presenting your work...

...and thanks also to those unable to attend who are still contributing presentations.

Thanks to Cornell for hosting the workshop and making all the arrangements.

“In preparing for battle I have always found that plans are useless, but planning is indispensable.” Dwight D. Eisenhower

“Life is what happens to you while you are busy making other plans.” John Lennon