The S0S1 Taskforce:
an Example of the Complexity for the ILC R&D Environment

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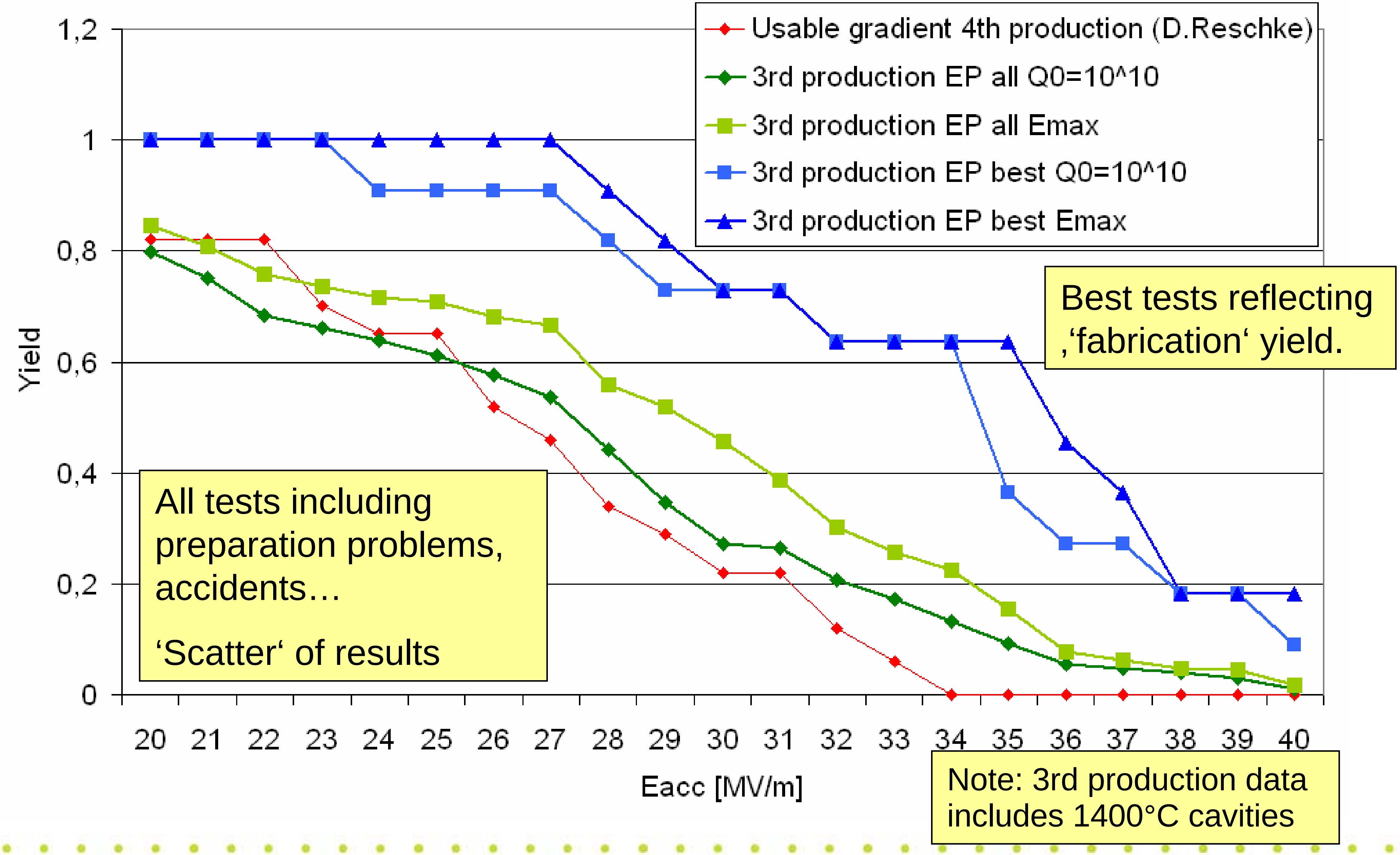
DESY

Cavity Yield

- The main problem with the cavity performance is getting enough cavities from the 1st run through the preparation process.
- 35 MV/m have been achieved in several cases
- A way to distinguish between problems from the fabrication and the preparation is to make certain cuts on the available data (from TTF database).
  - **Cavity Fabrication**
    - Look at the **best test** of each cavity of a production run
      - Excludes preparation to some degree, i.e. ‘will get it right eventually‘
      - Implicitly assumes that fabrication defects e.g. in the welds cannot be cured
  - **Cavity Preparation:**
    - Look at **all tests** of all cavities of a production batch
      - Includes all problems, change of procedures
- These assumptions on how the data is selected must be spelled out clearly
  - **Test database e.g. at TTF is an essential tool to evaluate/correlate data**

Cavity Yield



S0 Taskforce: Why???

- You just saw why… but here is the complete story:
  - **Cavity gradient possible, several cavities exceed 35 MV/m**
    - First test yield low
    - Re-processing increases yield, but is costly
    - Acceptance on initial test must be increased for large number of ILC cavities
  - **Focused R&D needed to demonstrate required cavity yield for ILC design gradient**
    - Timeline of the ILC needed quick startup on this topic
      - Be in time for EDR as that is the last chance to change this fundamental parameter
  - **International effort**
    - Several labs contribute with existing R&D program
    - Need to coordinate
      - Get priorities right to achieve cavity yield goal
      - Economize on resources

Problematic Issues to Be Coordinated

- Variety of cavity types is not helpful in the long-run
  - **Various lengths, flange systems, magnetic shielding, HOM damping etc.**
    - E.g. Ichiro and TESLA-like cavities at KEK, small changes can have large effects
  - **For the ultimate goal a single cavity type is needed**
    - Can be built and treated in different regions in parallel provided processes are transferable
- Variety of preparation recipes/setups and test culture
  - **Must develop protocols that guarantee transferable results**
    - Monitoring of parameters should make processes more transparent (e.g. HF content)
    - Exchanging cavities can facilitate
    - Develop common parameter set to be tested esp. for multi-cells
  - **Setups need to be qualified first (tight-loop)**
- Many process steps from niobium to cavity in accelerating module
  - **New vendors will have to learn**
  - **separate final process reproducibility from cavity reproducibility (includes fabrication)**
- Cavity development is ongoing
  - **Staging of cavity production is necessary to allow for evolution in cavity design and process improvements**
- Ultimately the number of cavities being built and treated will be small compared to the ILC number of cavities

S0S1: Common Test Protocols

Good example of a data set: Talk by E. Kako today!

ILC R&D Board Task Force on High Gradients (S0/S1)

Definition of Cavity Tests

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Version: 27-Jul-06

1.1 Introduction

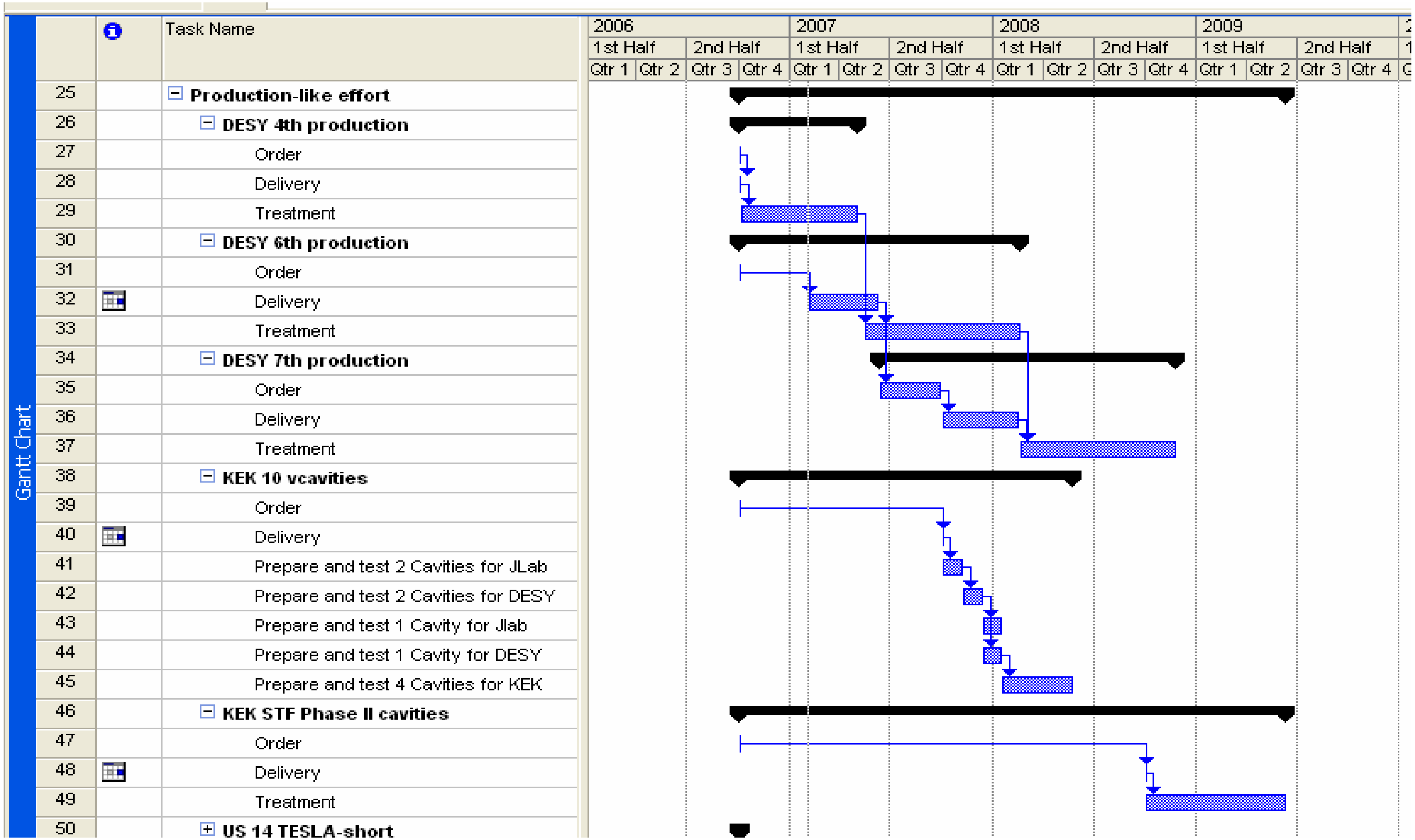
One goal of the task force must be to define a test procedure which results in a data set comparable between the laboratories. Due to the significant differences in infrastructures the test procedures differ significantly today.
Several limitations can be observed in superconducting cavities. They will be very briefly described in the following to make the definition of the testing procedure more transparent[1].

- Field emission
  - Electrons are emitted from the surface (at e.g. protusions and dust particles). These are accelerated and generate Bremsstrahlung.
  - Field emission can lead to a thermal breakdown due to the heating of the electrons impinging on the surface.
  - Detection:
    - Exponential increase of surface resistance with increasing accelerating field
    - X-ray monitoring shows exponential increase with higher accelerating fields
    - Temperature mapping shows typical traces

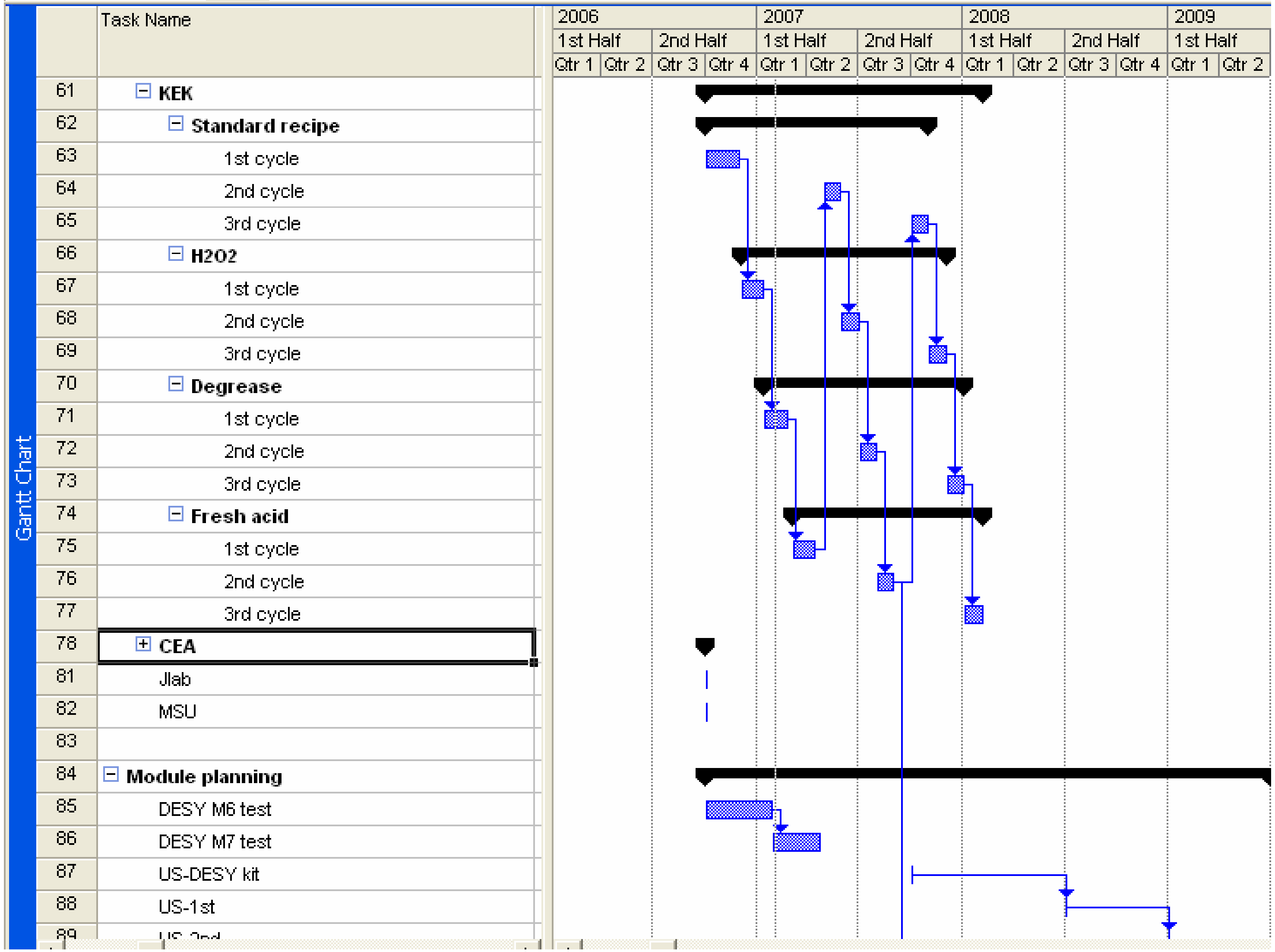
S0S1 Plan

- Timeline with different phases developed
  - **Focus on baseline**
    - TESLA Cavities, EP+800°C, …
  - **Tried to watch out for alternatives**
    - Avoid stopping useful R&D on high priority alternatives e.g. large-grain or low-loss shape (Ichiro)
- Detailed reasoning for the plan has been presented already
  - **Vancouver, Valencia, Wiki, Today (H. Hayano, S. Mishra)**
- Boundary conditions
  - **Limited resources**
    - E.g. real statistics require large number of cavities + sufficient preparation capacity
    - Has influence on alternatives
  - **Regional interest**
    - Might lead to duplication as several regions want to be capable of the core technology
- Need to manage
    - Project management tools
    - Manpower for tracking and coordination needed

Task Force View: Production-like efforts



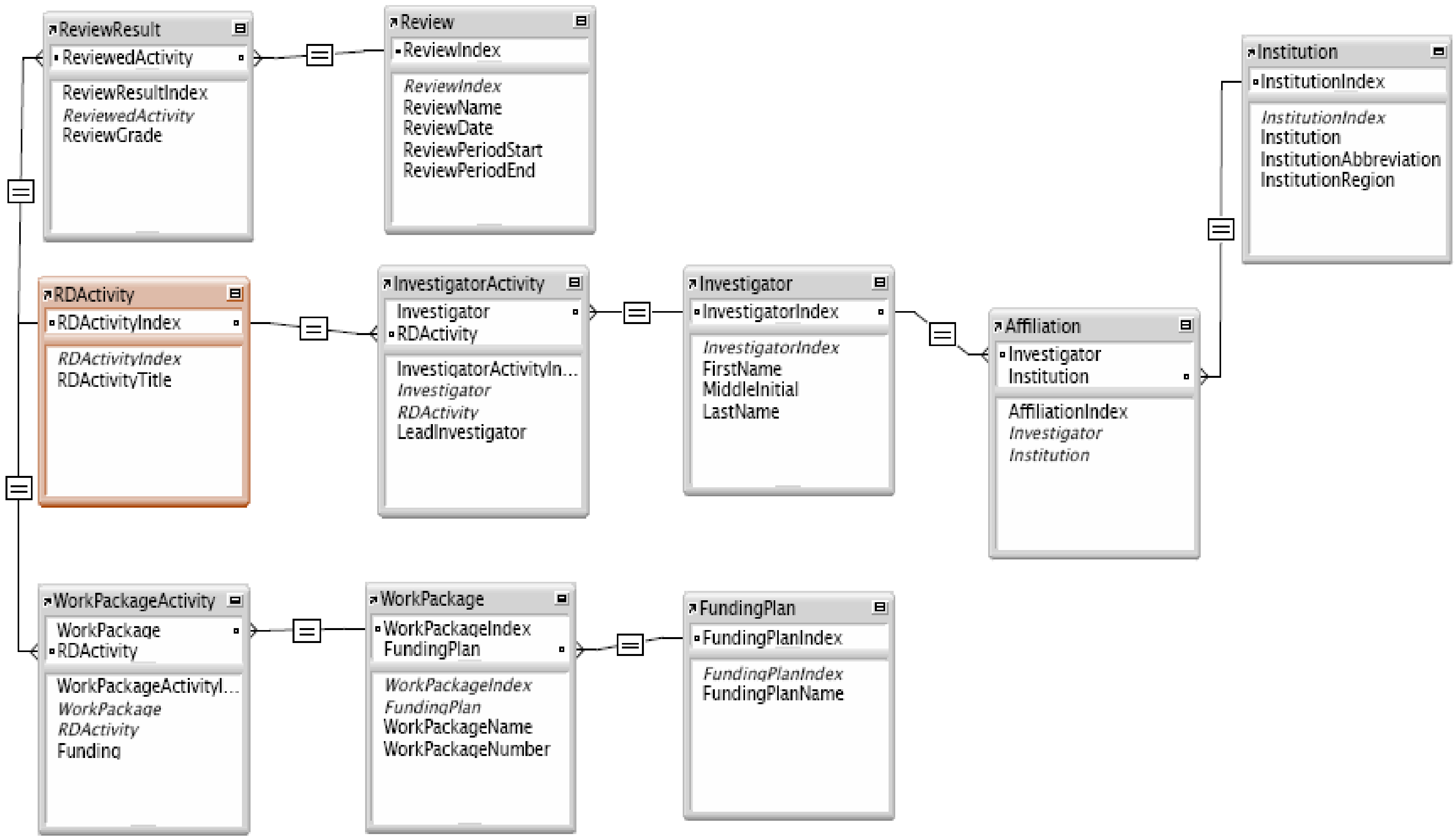
Taskforce View: Single-Cells and Modules



Projectizing S0S1: Project-Wide

- RDB
  - **Interface to various interests and responsibilities**
  - **Deliverables (major milestones) must be tracked**
    - Ultimately: Prepare for critical decision on gradient end 2008
  - **Distribution of resources**
    - Roll-up of costs and manpower of full program worldwide
    - Consultancy for regional programs e.g. FY07 programs in US, UK and Japan
  - **Prioritization**
    - Other systems, engineering needs
  - **Information to ILC Project management, Interface to EDR management**
  - **Tool:**
    - RDB database

RDB Database



S0 in RDB Database

GDE R&D Board
JFY2007

33

Leader	Saito
WP Title	*S0 9-cell cavity study*
Category	S0-45-9cell
Classification	Cavity
Comment	S0 US, TESLA, ICHIRO

The acceptable cavity performance for the ILC is Eacc = 35MV/m @ Qo=0.8E10 (BCD) or Eacc=40MV/m @ Qo=0.8E10(ACD). So far such performance is achieved with very low yield 20-30% at DESY. Establishment of the ILC cavity performance with high yield (>95%) is the first priority for ILC project. GDE RDB has set the S0/S1 R&D program to settle this problem. The S0 program consists of two categories: single-cell cavity and 9-cell cavity. The 9-cell S0 category has two studies: so called tight-loop and production-like studies. The tight-loop study is to develop the average gradient, Qo and performance scatter with ILC BCD preparation: EP(10-20μm) + HPR + Bake + Vertical test, repeating the process three times for each cavity. Three cavities with known performance from each

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xyz k$

Priority:

RDB Comment:

1. Processing capacity at KEK should be put to use (internationally). Number of cavities has to be matched not only for this task: very high.
2. Preference to 9-cell TESLA cavities supplied: very high.

S0 in RDB Database

GDE R&D Board
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69

Leader Hayano

WP Title *cavity Temperature-map system*

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Category R&D-Tmap

Classification Infrastructure

Comment Cavity Temp-mapping system

Priority: very high

RDB Comment:

Introduction of the cavity temperature mapping system for S0 experiment is very desirable and urgent. The current temperature monitor of cavity is done by only 4 point/cell. In order to identify the source of field emission, local heating at defects, or reason of multipacting, high density temperature monitor system and high time-resolution data-acquisition system is required. The system which are now under design and consideration are several types of mapping system for single-cell cavity, TESLA 9-cell cavity, Ichiro 9-cell cavity and TESLA-like 9-cell cavity. They are a mechanically rotational sensor type which is similar to DESY, and a type which is the combination of full multiple sensors and fast electronic multiplexer. The full multiple sensor type is developed by two ways. One has multiple cards

Projectizing S0S1: Interregional Task Level

- S0S1 Task force
  - **Deliverables must be tracked to more detail as in RDB**
    - Adjust plan if needed
    - Interfacing to RDB database
  - **Vetting of data**
  - **Scientific input into planning**
    - Comparison to alternatives
    - Input from developments outside of the ILC
  - **Tools:**
    - RDB database and e.g. MS Project

Projectizing S0S1: Interregional Task Level

- Project manager needed:
  - **‘Independent‘ of specific lab**
  - **Ensure communication between regions**
  - **Tracking**
    - Tasks and cavities
      - E.g. Paperwork
  - **Scientific**
    - Improvements to processes
      - E.g. better monitoring in VTA, , cavity preparation process
    - Data integration
      - Common data sets
      - Develop common protocols
    - Data evaluation e.g. low-power vs. high-power tests
  - **Tools:**
    - International test results database (a la TTF)
    - e.g. MS Project
    - Technical meeting
      - Could use of TTC video conference

Projectizing S0S1: Laboratory Level

- **Demonstrate understanding and control of the technology**
- **Detailed implementation of plan**
  - Scheduling of treatments
  - Assignment of resources (manpower)
- **Determination of effort needed**
  - Money for Treatments, Hardware
  - FTEs
- **Tools:**
  - Local project management tool
    - Good example by Shekhar Mishra today

ILC R&D Environment Continues to Develop

- General development
  - **With the change from RDR to EDR more project-like structure needs to be implemented for several topics**
- Engineering needs will influence program
  - **New ideas will develop from the engineering design level**
- R&D has been prioritized by RDB
  - **Global perspective essential**
  - **Has influenced the planning (funding) in regions already**
  - **Tried to find gaps, EDR phase will identify new gaps and/or de-emphasize current priorities**
  - **Re-evaluation on regular basis**

Summary

- S0S1 is one element of the complex R&D environment of the ILC which stretches from the project wide approach to the laboratory level
  - **Various responsibilities, needs and interests e.g. non-project wide funding**
- Project management tools are being implemented on these levels
  - **Global**
    - R&D database
  - **Interregional Task Level**
    - Plan developed
    - Project engineer needed to support implementation
    - Test results database to facilitate data analysis
  - **Lab tools**
- These have to support the communication flow and make the developments more transparent on an international level
  - **Also needed to adapt the expansion of the GDE as well as to changing needs i.e. beginning of the EDR phase**