Activities at KEK

NLC DoE Review at SLAC
May, 1999

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0. Introduction
1. Accelerating Structure
2. RF Power Creation and Distribution
3. Accelerator Test Facility
4. Conclusions
0. Introduction

See D. Burke's "NLC Overview" presentation for general introduction to the KEK-SLAC International Study Group (ISG) for joint pre-design efforts for a linear collider.

To iterate -

- Agreement on an R&D collaboration
- Sharing of tasks for expediting the progress based on common machine parameters:
  - @KEK
    - ATF
    - Fabrication and assembly of accelerating structure
  - @SLAC
    - NLCTA
    - Structure electrical design
  - Past and ongoing joint efforts
    - FFTB
    - DLDS development and testing
- All learning and technology to be made available to both parties under the protocol of: US-Japan agreement and SLAC-KEK MoU.
- Expecting to create inputs for taking the collaboration advanced in scope and participants in the near future.
- At this moment the exact form of the next-stage and/or ultimate collaboration is yet to be determined (e.g. JHEPC review in year 2000 in Japan, etc).
International Study Group (ISG) is a matching point of the R&D efforts / groups of the two labs:

Work-Group Coordinators for the KEK-SLAC ISG

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(Some other activities at each lab are conducted outside the scope of ISG)
1. Accelerating Structure

History

- Long-standing history in US-Japan collaboration.
- Unified scheme (DDS - Damped-Detuned Structure) has been jointly pursued since 1998.
- Successful assembly of DDS3 prototype structure in Japan, followed by beam testing at SLAC in 1997-98.
- Aggressive efforts towards realization of the first prototype structure based on the RDDS scheme (DDS with rounded cavity shape).

Status

- Design + building + testing techniques by and large at hand.
- Disk fabrication can satisfy approx +/− 1 µm tolerance.
- Diffusion bonding technique for the stack structure assembly has been successfully applied several times.
- Upon completion of the 1st RDDS prototype, the next step is
  (a) Refinement of the details of electrical design.
  (b) Assessment of manufacturing process with serious engineering eyes.
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Customer:  

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Department: MET-050  

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Max. Deviat.: 0.00050  
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Error Magnif.: 50  
No. of points: 188

X  Y  Z  Nr.  
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Inspector:  
Date: 12-MAR-98  
Time: 10:28:45
Microsense data [microns]

Cell #

V-block

Structure
2. RF Power Creation and Distribution

History

- Delay-Line Distribution system for RF power distribution has been jointly pursued by KEK and SLAC since ~ 1997.

- Klystron modulators: Information exchanges exist concerning basic component testing and development.

- Close exchanges of ideas on RF windows exist. Klystron development is somewhat separately pursued at SLAC and KEK. Possibility of some joint technology reviews is being explored.

Status

- Basic testing of mode-launching and extraction has been completed at low-power level at KEK in '98-'99.

- Power transfer through a ~ 50m delay line will be tested at ATF/KEK in summer '99 jointly (low-power).

- Upon completion of the delay line test this summer, the next step will be

  (1) High-power component studies.
  (2) Thorough system assessment (safety, failure modes, design refinements, fabrication issues...
Relationship between the RF Power and Bunch Train

- Modulator pulse
- Klystron RF drive (also, output)
- Time

- 360 ns + switch time
- Pulsed RF power, delivered to each accelerating structure cluster
- Filling time = ~ 100 ns

- 1.5 nC x 95 x 2.8 ns, i.e. 260 ns
- Bunch train

- ~ 1.53 µs

#1, #2, #3, #4
2 x 2 multi-mode DLDS System under Development

Divides the RF pulse into 4 clusters for delivery.
Reduces the waveguide length by factor 2/3, compared to the single-mode DLDS.
2-mode DLDS Test Experiment Setup

"Serpentine" mode converter

TE11 -> TE01

TE01+TE11 mode launcher

TE01 mode extractor

TE01 in

TE11 in

TE01 out

TE11 out

TE01 in

TE01 out
3. ATF (Accelerator Test Facility)

History

- Project as a test bench for the low-energy portion of an LC in Japan, since 1992. It consists of a 1.54 GeV S-band linac, beam transport, damping ring and extraction line.

- 20-bunch/train mulch bunch operation in 1994, with successful demonstration of beam-loading compensation.

- Commissioning / beam development of the damping ring since 1997.

- Very strong presence of SLAC collaborators, together with other labs / institutes from in/outside Japan.

Status

- In a single-bunch mode operation, nearly design horizontal emittance approx $1 \times 10^{-9}$ m has been achieved.

- Emittance coupling is 3 - 5 %, and requires more efforts to reach the target 1% level.

- Pilot studies of multi-bunch operation of DR has started.
The Compensating Structures

Total charge \(\sim 3.2 \times 10^{10}\) electron/ttrain

Energy Difference [%]

With ECS
Without ECS

Bunch Number
4. Conclusions

- KEK-SLAC collaboration on pre-design activities of an LC has been highly productive. A large amount of impressive progress has been made.

- Output of these efforts will become a basis for the discussion in Japan on how KEK and SLAC might formulate the near-future collaboration on more advanced-stage development of an LC design.