## APPENDIX A

MoU on ISG

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Here is a reproduction of the “Memorandum of Understanding between The High Energy Accelerator Research Organization (KEK) and The Stanford Linear Accelerator Center (SLAC) — International Linear Collider Optimization Study Group”.

A.1 Introduction

The High Energy Accelerator Research Organization (KEK) and the Stanford Linear Accelerator Center (SLAC) have long enjoyed a highly successful collaboration in the development of the accelerator physics and technologies for the next-generation high-energy electron-positron linear collider. Scientists and engineers at both laboratories concentrate on development of a collider based on the use of normal-conducting RF microwave technologies. Extensive collaboration exists between the two laboratories on the basic components of these technologies and on issues of collider design.

Development of the technologies required for a TeV-scale linear collider has advanced rapidly in recent years. Prototype RF components - klystrons, pulse compression systems, and accelerator structures - for such a collider are now being integrated into complete systems. Experiments with the Final Focus Test Beam (FFTB) have demonstrated the ability to demagnify and instrument beams suitably for the collider. The FFTB was built at SLAC by a broad international collaboration led by SLAC and KEK. Commissioning of a full-scale damping ring is now underway at the Accelerator Test Facility (ATF) at KEK. This too is being done by an international collaboration led by KEK and SLAC. Experiments with the ATF will provide the basis for the final design of the injector complex needed to prepare highly condensed beams for the linear collider.

The importance of international collaboration on large science projects has been well substantiated by experiences in high energy physics as well as in other fields. Successful collaboration requires potential partners to join in the early planning of the project and the management to foster growth of the collaboration. History shows that formation of a proper consensus and respect among potential participants requires conscious efforts by interested parties. The Directors of KEK and SLAC seek to develop collaboration on a linear collider in a way that is consistent with the independence and integrity of the participating communities. It is the purpose of this document to describe the basic features of a process to achieve this goal.

A.2 International Linear Collider Design Process

First design studies of a TeV-scale linear collider based on the use of normal-conducting RF microwave technologies have been conducted by scientists and engineers in Japan and the U.S. both jointly and in parallel. These studies have been documented as the NLC Zeroth-Order Design Report and the JLC ISG Progress Report, April, 2000
A.3. PRE-DESIGN ACTIVITIES OF THE INTERNATIONAL STUDY GROUP

Design Study. It is recognized by SLAC and KEK that together these studies and their supporting R&D provide the basis for optimizing the design of a collider that can be expected to successfully address the physics of the TeV energy scale.

The Directors of KEK and SLAC envisage a process that is hoped to lead to the realization of a linear collider built by an international collaboration. Such a facility would provide scientists from all regions of the globe with important opportunities for physics studies. As a first step KEK and SLAC agree in this Memorandum of Understanding (MOU) to form a Linear Collider International Study Group (ISG) to conduct certain pre-design optimization activities. These activities are outlined further below in this document. The task of the ISG is to produce a Pre-Design Report within one to two years of the signing of this MOU. The ISG will be led jointly by KEK and SLAC, but is expected to include substantial participation by other institutions from Japan and the United States as well as other nations.

The activities covered by this MOU can lead to a rapid and efficient development of an optimized design of a linear collider. To proceed beyond the scope of the R&D activities described in this MOU will require proper support by high energy physics communities and approval by the appropriate funding agencies in the U.S. and Japan.

A.3 Pre-design Activities of the International Study Group

It is too soon to address a number of issues related to an international project, particularly those that rely on a choice of host nation such as specific sites, construction responsibilities, and so on. It is important, however, to carry out the activities necessary to define and optimize the technical foundations of the project. These include:

- Specification of objectives and performance requirements for the collider.
- Identification of overall technical design strategies and options.
- Identification of subsystem and component functional requirements and technical options and designs.
- Description of civil engineering and infrastructure and models.
- Manufacturing and industrial engineering to improve cost efficiency.
- Evaluation of possible construction techniques and schedules.
- Remaining R&D items that need to continue.

These form the basis which must underpin any future collaboration on a collider project, and it is important that agreement be reached on these issues at an early stage in the development of the collaboration.

ISG Progress Report, April, 2000
A.4 Cost Efficiency and Industrialization

It is recognized that the cost of the collider will be a factor in determining the viability and schedule of completion of the facility. It is therefore important to arrive at a component and system designs that minimize costs while being consistent with the performance requirements set by the particle physics goals.

Industrialization and design manufacturability will be a significant component of the R&D program supported by the ISG.

A.5 Organization of International Study Group

An attached figure shows the proposed organizational chart of the ISG. We give here a brief description of the structure and roles of the various components of the organization. It is anticipated that these structures and activities may change as the work of the ISG evolves.

The “Director Group” is led by the Directors General of SLAC and KEK and contains a small number of executive members from each institution. The role of this group is to provide overall direction to the work of the ISG and to provide contact and coordination with the institutions participating in the ISG.

The Physics and Detector Technologies Working Groups will be structured to allow discussion and investigation of the physics goals for the linear collider and the various detector technologies that would be appropriate for experiments at the collider. Coordinators for these Working Groups will be chosen to provide contact with the scientific communities of all regions with interest in use of the linear collider. It is expected that the Director Group will identify overall coordinators for these Working Groups. The Background and IR Working Group is specially charged to work closely with the Collider Design Working Groups to make certain the needs of the detector are integrated into the design of the collider.

The Collider Design Working Groups will be structured to carry out the pre-design activities of the linear collider. The Coordinators for these groups will be chosen to have experience and expertise in the appropriate areas and to represent the institutions involved in the design. It is expected that representatives from KEK and SLAC will provide overall coordination of the pre-design activities.

Ad-hoc advisory groups may be established by the Director Group from time to time to provide consultation on various issues.

*ISG Progress Report, April, 2000*
A.6 Concurrence

Burton Richter
Director, Stanford Linear Accelerator Center

Hirotaka Sugawara
Director General, High Energy Accelerator Research Organization
APPENDIX A. MOU ON ISG

Collider Study Leaders

Physics and Detector Study Leaders

Physics WG
Detector Technology WG
Bkgnd and IR WG

Collider Study Leaders

WG
WG
WG

Work groups

International Linear Collider Study Group
APPENDIX B

ISG Meeting History

B.1 Meeting Chronology

Major ISG meetings have been held approximately every six months at locations alternating between SLAC and KEK (Table B.1). Each of these extensive working meetings has lasted 4 to 5 days, and has been attended by 40-50 persons from the two laboratories and other institutions and corporations. Typically 25 people fly across the Pacific Ocean for each meeting. Details of the agenda, list of participants, and copies of the presentation materials are available online.

Table B.1 lists the major ISG meetings that have been held since its beginning up to the present time. Each major meeting has been held approximately six months apart, with the host laboratories alternating between SLAC and KEK. A major meeting, which lasted 4 to 5 days each, has been attended by typically 40 - 50 persons from the two labs and collaborators from other institutes.

In addition, in many cases a major ISG meeting was preceded by a pre-ISG meeting where a limited number of physicists from SLAC and KEK met and laid out the meeting agenda and goals. Also, members of ISG work groups frequently traveled to each other’s laboratory for conducting specific discussions, experiments and measurements other than for the major meetings.

1http://lcdev.kek.jp/ISG/ and
http://www-project.slac.stanford.edu/lc/ilc/ISGMeetings/isg_index.html
APPENDIX B. ISG MEETING HISTORY

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Date</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISG1</td>
<td>January, 1998</td>
<td>SLAC</td>
</tr>
<tr>
<td>ISG2</td>
<td>July, 1998</td>
<td>KEK</td>
</tr>
<tr>
<td>ISG3</td>
<td>January, 1999</td>
<td>SLAC</td>
</tr>
<tr>
<td>ISG4</td>
<td>July, 1999</td>
<td>KEK</td>
</tr>
<tr>
<td>ISG5</td>
<td>February, 2000</td>
<td>SLAC</td>
</tr>
</tbody>
</table>

Table B.1: List of past ISG meetings.

The ISG has been an effective collaboration that has enhanced the efforts of both sides. Some of the major accomplishments of the ISG are described in the next section.

B.2 Meeting Agenda and Goals

B.2.1 ISG1 – January, 1998 at SLAC

The ISG1, held in January of 1998 at SLAC, was the first major meeting. The primary focus of this meeting was the following:

a) Begin identification of overall technical design strategies and options for a TeV-scale linear collider based on room-temperature RF technologies. This is so as to start joint efforts towards development of mutually compatible system concepts and hardware components at both SLAC and KEK.

b) Layout the plans for joint development of system concepts and hardware components in the following areas:
   - Main linacs RF power compression and distribution,
   - Main linacs accelerating structures.

c) Review injector facility to identify major lessons and issues for future study.

Table B.2 summarizes the tasks assigned to each work groups.

B.2.2 ISG2 – July, 1998 at KEK

The overall goal for the ISG2 meeting was the following:

*ISG Progress Report, April, 2000*
Fix the LC working parameter set, and produce specific plans for R+D efforts in each subsystems selected for this meeting.

The WGs set up for this ISG2 meeting are listed in Table B.3. The critical WG goals are also given. The WG co-chairpersons are indicated within parentheses.

The major accomplishment of ISG2 was tentative agreement on the overall machine parameters and agreement to focus on development of damped-detuned scheme for the accelerating structure.

B.2.3 ISG3 – January, 1999 at SLAC

The overall goal of the Third SLAC-KEK ISG meeting is the following:

- Review the progress of each working group and to make specific plans for future work.
- The ISG will publish a progress report by the end of the 1999 calendar year. A specific task for this meeting is to create an outline of this progress report and to agree on the detailed design and R&D goals to be achieved in time for its preparation.
- Six Working Groups (WG) participated in the second ISG meeting at KEK last July and will continue their efforts at this third session.

The general goals of the WGs are outlined in Table B.4.

B.2.4 ISG4 – July 1999 at KEK

The overall goal of ISG4 was as follows:

- Define final goals and work plans for each working group within ISG, with emphasis on the tasks that are required towards the ISG Progress report.
- Launch the klystron sub-working group under the RF modelling working group.
- Start preparatory work on the ISG Progress Report. In addition, create a preliminary lists of work that might continue beyond completion of the ISG Progress report.

The specific goals of individual WGs were as outlined in Table B.5.

B.2.5 ISG5 – February, 2000 at SLAC

Following is the message that was circulated among the collaborators, stating the goals and plans for ISG5:

ISG Progress Report, April, 2000
The SLAC-KEK ISG Collaboration on linear collider R&D has made great progress towards the goals set forth in the joint laboratory MOU. There remains much to do. At this fifth meeting of the ISG Collaboration we will review our progress to date and discuss a completed first draft of the ISG Progress Report that will be delivered to the KEK and SLAC Directors at the end of March of this year. We will also discuss goals for joint R&D to continue beyond the completion of the Progress Report, and specific plans for the coming year will be made.

The same set of work groups as ISG4 discussed on numerous issues. The specific agenda set is available on the web \(^2\).


*ISG Progress Report, April, 2000*
### WG1. Parameters

a) Create a baseline, common parameter set for the main linacs so that mutually compatible hardware component development can be initiated at both SLAC and KEK.

b) Conduct a systematic survey of parameter scaling for the purpose a) above. Discuss multi-bunch tolerances in conjunction with the structure length, pulse length and bunch spacing.

c) Discuss advantages and disadvantages of using C-band to increase the injection energy in the main linacs.

d) If definitive conclusions cannot be reached during this meeting, summarize the open issues and propose how the near-future efforts towards the goal a) might be organized.

### WG2. Injectors

a) Create written plans for joint development of system concepts and hardware components for the main linacs RF power distribution system and the main linacs accelerating structure machining and assembly, for the subsequent 1 year.

b) Collect relevant performance and lesson issues (Do not discuss practical and detailed hardware issues, for instance, at ATF. Rather, extract the essence from the specific experiences).

c) Make a prioritized list of issues from the discussion topics in a) and b), so as to indicate what we expect to accomplish in the subsequent 6 months.

### WG3. Main Linacs

a) Create written plans for joint development of system concepts and hardware components for the main linacs RF power distribution system and the main linacs accelerating structure machining and assembly, for the subsequent 1 year.

b) Interact with WG1 so as to ensure that the common parameter set is a scientifically and technologically sound one.

c) Make a prioritized list of other issues, including structure support, requirements for the facility stability, field emission and RF breakdown studies. Indicate there how we expect to start working on these in the subsequent 6 months.

### WG4. RF Modeling

a) Create a list of tasks and potential technical choices to pursue in the area of numerical modeling of high-power RF systems.

b) Investigate how joint efforts in a) might be conducted by SLAC and KEK, and make a proposal with possible options.

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*Table B.2: Tasks for work groups at ISG1.*
<table>
<thead>
<tr>
<th>WG1. Parameters (K. Yokoya (KEK) and T. Raubenheimer (SLAC))</th>
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<tbody>
<tr>
<td>a) Start translating the working parameter set into specifications of each subsystem.</td>
</tr>
<tr>
<td>b) Start evaluating critical tolerance numbers to pay attention to.</td>
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<tr>
<td>WG2. Injectors (H. Hayano (KEK) and J. Sheppard (SLAC))</td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>a) Start design work of Pre-Damping Rings and Damping Rings which are compatible with the bunch train length $\sim 240 \text{ ns}$.</td>
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<tr>
<td>b) Produce plans for joint R+D efforts on the polarized electron sources.</td>
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<tr>
<td>WG3. Main Linac Accelerating Structure (T. Higo (KEK) and J. Wang (SLAC))</td>
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<tr>
<td>---------------------------------------------------------</td>
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<tr>
<td>a) Produce plans for R+D on the main linac accelerating structures following DDS3.</td>
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<tr>
<td>WG4. Klystron Modulators (M. Akemoto (KEK) and R. Cassel (SLAC))</td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>a) Start discussions on the joint R+D plans for the klystron modulators.</td>
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<tr>
<td>WG5. RF Modelling (Y.H. Chin (KEK), A. Vlieks (SLAC) and S. Tantawi (SLAC))</td>
</tr>
<tr>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>a) Produce concrete plans for component development and mode-mixing experiments for DLDS, and development of RF windows.</td>
</tr>
<tr>
<td>b) Produce specific plans for joint development of PPM klystrons.</td>
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<tr>
<td>WG6. Interaction Region (T. Tauchi (KEK) and T. Markiewicz (SLAC))</td>
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<tr>
<td>---------------------------------------------------------</td>
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<tr>
<td>a) Start evaluating joint research plans for issues in the interaction region (IR).</td>
</tr>
</tbody>
</table>

*Table B.3: Tasks for work groups at ISG2.*
## B.2. MEETING AGENDA AND GOALS

### WG1. Parameters (K. Yokoya (KEK) and T. Raubenheimer (SLAC))
- Evaluate critical tolerances for the collider performance
- and provide support for the other working groups

### WG2. Injectors (H. Hayano (KEK) and J. Sheppard (SLAC))
- Compare and contrast JLC and NLC beam parameters specifications.
- Highlight and understand differences.
- Discuss main damping ring lattice designs.
- Discuss NLC damping ring development programs.
- Discuss beam loading compensation in the injector linacs, capture regions and compressor sections for the JLC and NLC.
- Meet with the JLC/NLC Parameter Group.

### WG3. Main Linac Accelerating Structure (T. Higo (KEK) and J. Wang (SLAC))
- Review experiences with existing structures.
- Review status and plans for the RDDS1 structure now under construction.
- Outline goals for the remainder of the year, and discuss longer range ideas and plans for the designs and fabrication of structures.

### WG4. Klystron Modulators (M. Akemoto (KEK) and R. Cassel (SLAC))
- Discuss plans for klystron modulator development with particular emphasis on performance and technical specifications for solid-state switching devices and their availability in industry.

### WG5. RF Modelling (Y.H. Chin (KEK), A. Vlieks (SLAC) and S. Tantawi (SLAC))
- Discuss and review plans for design and testing of high-power components.
- Review performance expectations for various pulsed-power systems.
- Outline goals for the remainder of the year and discuss longer range ideas and plans for development and testing of high-power components and systems.

### WG6. Interaction Region (T. Tauchi (KEK) and T. Markiewicz (SLAC))
- Review results from simulations of detector backgrounds and needed future calculations and measurements.
- Review the status of the designs of the interaction region, methods to stabilize the beam collisions, and techniques to measure the parameters of the beam collisions that are needed to carry out experiments at linear colliders.
- Outline goals for the remainder of the year.

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**Table B.4: Tasks for work groups at ISG3.**
APPENDIX B. ISG MEETING HISTORY

WG1. Parameters (K. Yokoya (KEK) and T. Raubenheimer (SLAC))

Lead the discussions towards preparation of the ISG Progress Report.
Continue efforts in establishing the mechanism for transferring and translating beam line design data (MAD/SAD decks) between KEK and SLAC.
Assist other WGs, particularly WG2 and WG6 in reviewing the design parameter issues their respective area.

WG2. Injectors (H. Hayano (KEK) and J. Sheppard (SLAC))

Review the design parameter issues in the injector area, in particular, the design choices for the position production system.
Review the latest progress made at ATF. Create possible plans for near-future collaboration programs at ATF.

WG3. Main Linac Accelerating Structure (T. Higo (KEK) and J. Wang (SLAC))

Continue on the all-out efforts towards realization of the first prototype accelerating structure based on the Rounded Damped-Detuned concept (RDDS1).
Discuss longer range ideas and plans for the design and fabrication of structures.

WG4. Klystron Modulators (M. Akemoto (KEK) and S. Gold (SLAC))

Discuss plans for klystron modulator development.
Review the progress made so far on performance and technical specifications for solid-state switching devices and other technologies available in industry.

WG5. RF Modelling (Y. H. Chin (KEK) , A. Vlieks, E. Jongewaard and S. Tantawi (SLAC))

Discuss and review plans for design and testing of high-power components, in particular, test experiments on the RF mode transfer on DLDS and RF windows.
Launch a new subgroup on X-band klystron development and start mutual reviews on development efforts at SLAC and KEK towards high-power X-band klystrons which use permanent magnets for beam focussing.

WG6. Interaction Region (T. Tauchi (KEK) and T. Markiewicz (SLAC))

Review results from simulations of detector backgrounds and needed future calculations and measurements.
Review the status of the designs of the interaction region, methods to stabilize the beam collisions, and techniques to measure the parameters of the beam collisions that are needed to carry out experiments at linear colliders.
Outline goals for the remainder of the year.

Table B.5: Tasks for work groups at ISG4.