

International Study
of
Physics and Detectors
for
Future Linear e^+e^- Colliders

C. Baltay
SLUO Meeting
July 15, 1998

Recent Studies

1. NLC Study in the US
2. JLC Studies in Japan
3. TESLA Studies in Europe

Series of International e^+e^- Workshops

- Finland 1991
- Hawaii 1993
- Japan 1995
- Barcelona Apr. 28 - May 4 1999
(Sitges)

PHYSICS WITH HIGH ENERGY e^+e^- COLLIDERS

A series of Workshops to study the physics potential of High Energy e^+e^- Colliders, held in preparation for the 1996 SNOWMASS Study.

- Organizational Meeting at Yale Feb 11, 1995
- Set up Physics Working groups
- Series of Workshops
 1. Estes Park, Colorado June 23-25, 1995
 2. Fermilab Nov 16-18, 1995
 3. SLAC Feb 29-March 2, 1996
 4. Brookhaven Natl Lab May 6-8, 1996
- SNOWMASS Study June 24-July 12, 96

High Energy e^+e^- Physics Study Groups

1. **Theoretical Support**
Mike Peskin, Gordie Kane, Bill Marciano
2. **Higgs Searches**
Peter Rowson, Rick VanKooten
3. **Supersymmetry**
Steve Olsen, Uriel Nauenberg, Bob Hollebeek
4. **Strong WW Scattering, other signatures of strongly interacting symmetry breaking**
Tim Barklow, Harry Nelson, Tao Han
5. **Top Physics**
John Jaros, Ray Frey, Rajendran Raja
6. **QCD Studies**
Phil Burrows, Bruce Schumm
7. **ZWW & Gamma WW couplings, anomalous W properties**
Keith Riles, Jim Brau
8. **New Z's, quarks, leptons, other exotica**
Kirk McDonald, Kaori Maeshima, Tom Rizzo
9. **Detector Layout & Parameters**
Bob Jacobsen, Marty Breidenbach
10. **Interaction region and backgrounds**
Tom Markiewicz, Stan Hertzbach
11. **Special purpose experiments and detector ($\gamma\gamma$, γe , e^+e^- , etc.)**
Clem Heusch, Dan Bauer
12. **Simulation Software**
Steve Manly
13. **Physics Scenarios**
David Burke, Richard Stroynowski

+ Studies in Europe & Japan

+ SNOWMASS 96

The time has come for a new
round of International Physics
and Detector Studies

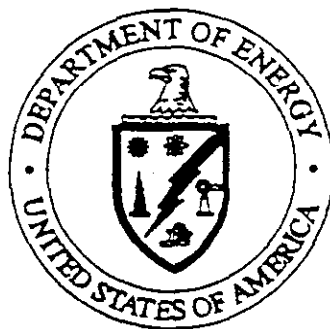
Some Recent Developments:

1. Favourable Recommendation from the Gilman Panel
2. MOU with Japan signed
3. Significant ILC Detector R&D Funds expected in FY99

The Gilman Panel

HEPAP Subpanel Report on
PLANNING FOR THE FUTURE OF
U.S. HIGH-ENERGY PHYSICS

February 1998



U.S. Department of Energy
Office of Energy Research
Division of High Energy Physics
Washington, D.C. 20545

Linear Collider

The design of a linear collider is more developed than the design of a muon collider or that of a VLHC, and construction could potentially begin in the next decade. The SLC at SLAC, designed and built in the 1980s to study the Z boson, is the first and only example of an electron-positron linear collider and provides a test bed for further development of the linear collider concept. In the 1990s, an international collaboration was set up to study and develop technologies for the next step in energy and luminosity, with SLAC and Japan's KEK leading the R&D effort toward a machine that would use room-temperature rf cavities to accelerate the beams and Germany's DESY leading the corresponding effort for superconducting cavities. KEK and SLAC have recently signed a Memorandum of Understanding to work on R&D toward a common design. The next step is the production of a Conceptual Design Report (CDR) with a complete technical design and associated costs and schedules for specific sites. DESY plans to complete a CDR for a superconducting machine in the next several years as well.

Recommendation:

The Subpanel recommends that SLAC continue R&D with Japan's KEK toward a common design for an electron-positron linear collider with a luminosity of at least $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ and an initial capability of 1 TeV in the center of mass, extendible to 1.5 TeV. The Subpanel recommends that SLAC be authorized to produce a Conceptual Design Report for this machine in close collaboration with KEK.

This is not a recommendation to proceed with construction. A decision on whether to construct a linear collider should only follow the recommendation of a future subpanel convened after the CDR is complete. The decision will depend on what is known about the technology of linear colliders and other potential facilities, costs, international support, and advances in our physics understanding.

Memorandum of Understanding
between
The High Energy Accelerator Research Organization (KEK)
and
The Stanford Linear Accelerator Center (SLAC)
International Linear Collider Optimization Study Group

1 Introduction

The High Energy Accelerator Research Organization (hereinafter known as "KEK") and The Stanford Linear Accelerator Center (hereinafter known as "SLAC") have long enjoyed a highly successful collaboration in the development of a 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.

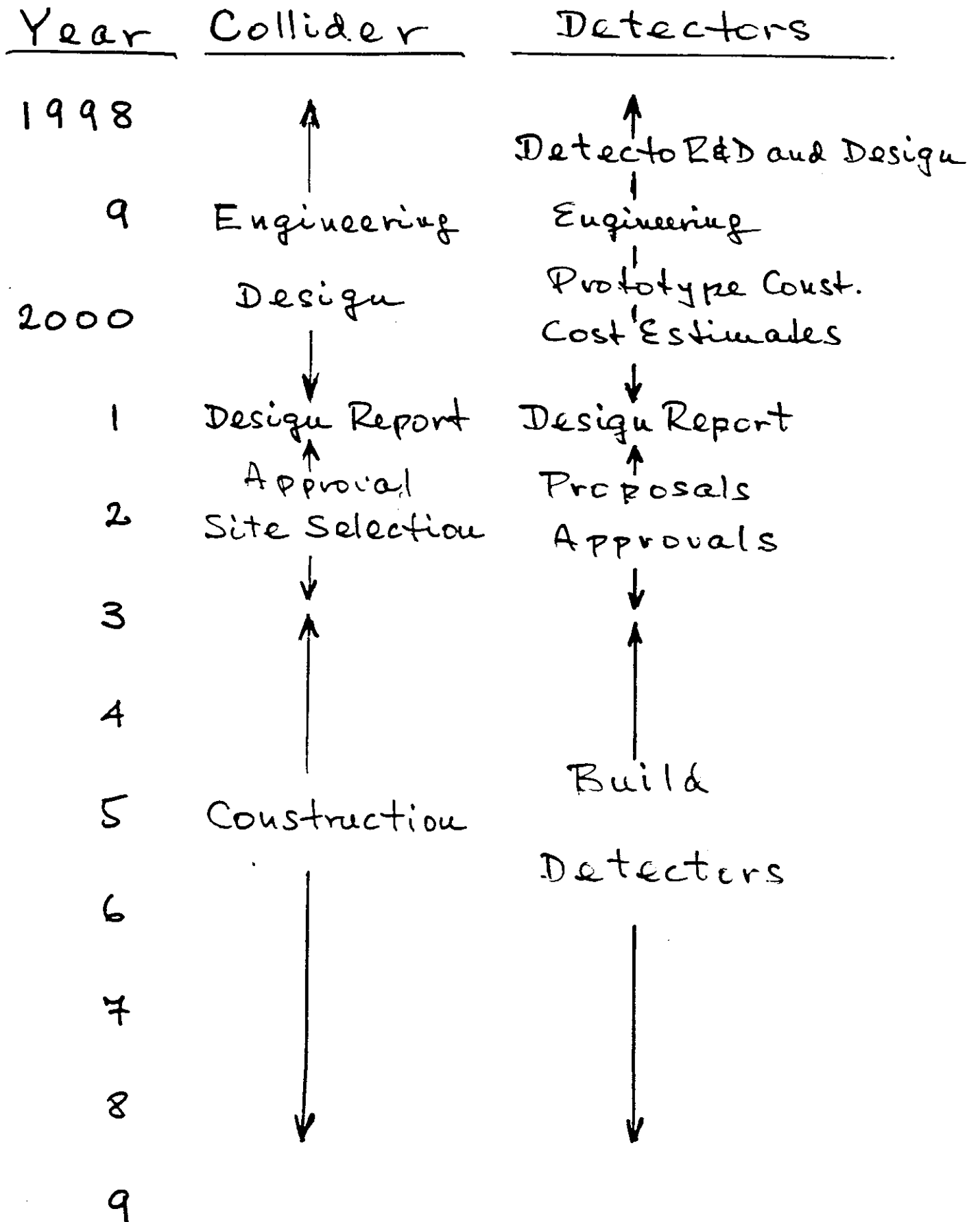
The importance of international collaboration on large science projects has been well substantiated by experiences in high energy physics as well as in other fields. Successful collaboration requires potential partners to join in the early planning of the project and the management to foster growth of 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.

Goals of the International Physics and Detector Study

Valid regardless of the eventual geographic location of the e^+e^- LC

1. Further study of relevant Physics Processes with a focus on providing guidance on the parameters required for both the Collider and the Detectors.
2. Start building an international user community and the international collaborations necessary to design and build (presumably 2) detectors
3. Start serious Detector R&D with the goal of having Detector Design Reports (LOI's?) in 3 years with significant engineering and rough cost estimates.

Proposed ILC Timescales



Proposed Plan for the International
CTE Physics & Detector Study

C. Baltay, S. Komamiya, D. Miller

1. Set up joint international Working Groups

Detector Groups

1. Vertex Detectors
2. Tracking
3. Particle I.D.
4. Calorimetry
5. Muon Detector
6. Data Acquisition / Electronics

Physics Groups

7. Higgs
8. SUSY
9. Other new particles
10. Top Physics
11. QCD, two photon
12. Electroweak, strong gauge interactions

Groups joint with Machine People

13. e^-e^- , $e\gamma$, $\gamma\gamma$ options
14. Interaction region, backgrounds

Additional groups can be set up
later as appropriate.

2. Operation of the Working Groups

a) Each working group will have 3 coleaders, 1 from each region (U.S., Japan, Europe)

b) The whole international working group will meet several times a year, as appropriate and possible.

c) More frequent activity on the local level as required, under the coordination of the 3 group leaders.

Proposed Plan of Action

1. Meetings, discussions with C.B., Komamiya, Miller, Burke, Iwata, other US, Japanese & European physicists, consultations with Lab Directors and DOE etc. to develop proposed plan
1997 through May 1998
2. Meeting with 2 dozen or so potential N. American leaders of these studies Boulder, June 11-12, 98
3. Meeting of an international Organizing Committee (~5 from each region: U.S. et al, Japan et al, Europe et al)
Adjacent to Vancouver meeting (TRIOHF) July 29, 98
4. First meeting of the Working Groups to organize and start work
All interested scientists will be invited (urged) to attend this meeting or send representatives
Sept. 1998 (?)

KEYSTONE, Colorado Sept 26-29, 1998

BOULDER NLC MEETING

June 11, 12, 1998

AGENDA

MILLENNIUM ROOM
REGAL HARVEST HOUSE HOTEL
1345, 28th St., Boulder

THURSDAY, June 11

| | | |
|------------------|---|----------------|
| 2:00 - 2:30 p.m. | NLC Collider Plans & Schedule | David Burke |
| 2:30 - 3:00 p.m. | NLC Physics & Detector Studies | Charlie Baltay |
| 3:00 - 3:30 p.m. | COFFEE BREAK | |
| 3:30 - 5:30 p.m. | Discussion | |
| | a) General Goal and Nature of Study. | |
| | b) Working Groups Goals and Charge. | |
| | c) Tentative Selection of Leaders and Co-Leaders. | |
| | d) Detector R&D Program. | |
| | Funds Available | |
| | Generation of R&D Plans and Proposals | |
| | Process of Fund Allocations | |
| | e) September NLC Detector R&D Workshop | |
| | Place, Time, Duration | |
| | Select Organizing Committee | |
| 5:30 - 6:00 | Issues on Detector Parameters | Keith Riles |
| 6:30 - 10:00 | COCKTAIL, DINNER and Further Discussion if necessary. Suite 431. | |

FRIDAY, June 12

| | | |
|---------------|--|----------------|
| 8:00 - 9:00 | CONTINENTAL BREAKFAST | |
| 9:00 - 9:30 | Detector R&D Issues | Jim Brau |
| 9:30 - 11:30 | Discussion | |
| | a) Continuation of Previous Day Topics | |
| | Confirmation of Leaders and Co-Leaders | |
| | COFFEE BREAK | |
| | b) Discussion of Detector R&D Issues | |
| 11:30 - 12:00 | Concluding Remarks | Charlie Baltay |

ADJOURN

Working Group I.O.'s (Interim Organizers)

- At this meeting make tentative choices for ~two I.O.'s for each Working Group:
 - 1st. I.O. : will serve as the North American Coleader of the International Working Group, to be ratified by Int'l Organizing Committee
 - 2nd I.O. : Will work with 1st leader of each group in all other ways.
- The I.O.'s of each working group should:
 - a) Recruit members for their working group, start organizing group
 - b) Help organize September NLC Workshop
 - c) Coordinate activities of their group
 - d) The I.O.'s of the Detector working groups should coordinate, in the next 6 months:
 - Development of R&D plan for their group
 - Development of R&D Proposal, with suggested funding for R&D for each member institution
 - Try to bring R&D requests from member institutions into possible ...

Working Group Interim Organizers

1. Vertex Detector
Jim Brau, Harry Nelson
2. Tracking
Keith Riles, Dean Karlen, Chris Hearty
3. Particle I.D.
Hitoshi Yamamoto, Richard Stroynowski
4. Calorimetry
Frank Porter, Ray Frey
5. Muon Detector
Dave Koltick, Jack Ritchie
6. Data Acquisition/Electronics
Tony Barker, Bob Jacobson
7. Higgs
Rick Van Kooten, Bill Marciano
8. SUSY
Teruki Kamon, Bob Hollebeck^z, H. Murayama, U Nauenberg
9. Other New Particles
Slawek Tkaczyk, Joanne Hewett
10. Top Physics
David Cinabro, Dave Gerdes, Andreas Kronfeld
11. QCD, Two Photon
Bruce Schumm
12. Electroweak, Strong Gauge Interactions
Tim Barklow, Mike Peskin
13. e^-e^- , $e\gamma$, $\gamma\gamma$ Options
14. Interaction Regions, Backgrounds
Tom Markiewicz_c

Organizing Committee
of the
International Study of Physics and Detectors
for Future Linear e^+e^- Colliders

Charles Battay Sadio Komamiya Dave Miller
Yale Univ. U. of Tokyo UC London

Alan Astbury TRIUMF
Jonathan Bagger Johns Hopkins
Paul Graunis Stony brook
Steve Olsen Hawaii
Charles Prescott SLAC

Shinboung Kim Tsukuba
Sun Kee Kim Seoul (Korea)
Takayuki Matsui KEK
Toshiaki Tauchi KEK
Tao Huang Beijing

Michael Danilov ITEP
Rolf Heuer CERN/DESY
Marcello Piccolo Frascati
Francois Richard Orsay
Ron Settles Munich

From: YLWS07::DEVORE 25-JUN-1998 16:27:46.54
To: in%"cath@fnald.fnal.gov"
CC: baltay
Subj: Announcement for the DPF Newsletter

WORKSHOP ON PHYSICS AND DETECTORS

FOR FUTURE e+e- LINEAR COLLIDERS

September 26-29, 1998

at

Keystone, Colorado

There will be a four day workshop on the physics and detectors for future e+e- linear colliders, held at the Keystone Resort in Colorado on September 26-29, 1998. The purpose of this workshop is to start organizing the U.S. effort to participate in an International study on the physics and detectors for future e+e- linear colliders.

There will be significant funding available for R&D on detectors for future e+e- colliders starting in FY1999. Part of the purpose of this workshop will be to set up working groups to start developing a detector R&D plan, leading to R&D proposals for the first round of R&D funds available in FY1999.

This workshop will be open to all scientists interested in future e+e- detectors. More details will be made available later.

For information contact:

Charles Baltay (charles.baltay@yale.edu) or
Uriel Nauenberg (uriel%colohe@vaxf.colorado.edu)

Keystone Meeting

Sept. 26-29, 1998

Dear Colleagues:

Here is the announcement we have sent out to Cathy Newman Holmes (DPF), Dave Miller (in Europe) and Sachyo Komamiya (in Japan) for e-mail distribution. I hope this is O.K.

Regards,
Uriel

| |
|--|
| WORKSHOP ON PHYSICS AND DETECTORS FOR FUTURE e+ e- LINEAR COLLIDERS |
|--|

Following the recommendations of the recent HEPAP Gilman Subpanel, a series of workshops and a set of working groups are being organized to study the physics and detectors of future electron-positron linear colliders. The first of these workshops will be held at Keystone, Colorado from Saturday, September 26 through Tuesday noon, September 29, 1998. A purpose of this workshop is to start organizing the regional effort to participate in an international study on the physics and detectors associated with these colliders.

There will be funding available for R&D on detectors for future e+e- colliders starting in FY99. Part of the purpose of this workshop will be to set up working groups to start developing a detector R&D plan, leading to R&D proposals for the first round of R&D funds.

All scientists who wish to participate in this effort are invited to attend, and all groups who may have an interest in this program are urged to have some representation at this workshop.

See the web <http://hep-www.colorado.edu/LC/workshop.html> for further information and registration. For help contact Kathy Oliver at oliver@colohe.colorado.edu.

Keystone Meeting

Organizing Committee

Charles Baltay, Uriel Nauenberg (co-chairs)

Organizers by Topics

Vertex Detectors: Jim Brau (U. of Oregon), Harry Nelson (U. of California, Santa Barbara)

Tracking: Keith Riles (U. of Michigan), Dean Karlen (Carleton U.)
Chris Hearty (U. of British Columbia)

Particle I.D.: Hitoshi Yamamoto (U. of Hawaii), Richard Stroynowski
(Southern Methodist University).

Calorimetry: Frank Porter (CALTECH), Ray Frey (U. of Oregon)

Muon Detector: David Koltick (Purdue U.), Jack Ritchie (U. of Texas)

Data Acquisition/Electronics: Anthony Barker (U. of Colorado), Bob
Jacobsen (U. of California, Berkeley)

Higgs: Rick Van Kooten (U. of Indiana), William Marciano (BNL)

SUSY: Teruki Kamon (Texas A&M), Bob Hollebeek (U. of Pennsylvania),
Hitoshi Maruyama (UC Berkeley/LNBL),
Uriel Nauenberg (U. of Colorado).

Other New Particles: Slawek Tkaczyk (Fermilab), Joanne Hewett (SLAC)

Top Physics: David Cinabro (Wayne State U.), Dave Gerdes (U. of
Michigan), Andreas Kronfeld (Fermilab)

QCD, Two Photon: Bruce Schumm (U. of California, Santa Cruz)

Electroweak, Strong Gauge Interactions: Tim Barklow (SLAC), Michael
Peskin (SLAC)

Interaction Regions, Backgrounds: Tom Markiewicz (SLAC)

e-e-, e-gamma, gamma-gamma: To be determined.

Local Organizing Committee

Anthony Barker (U. of Colorado)
John Harton (Colorado State U.)
Uriel Nauenberg (U. of Colorado) (chair)
Walter Toki (Colorado State U.)
David Wagner (U. of Colorado)
Robert Wilson (Colorado State U.)

This workshop is supported in part by the U.S. Department of Energy.

Detector Design & R&D Issues

1. Overall Detector philosophy & configuration
2. Desired Performance Parameters
3. Component technology choices
4. One detector or two ?
5. Role of e^-e^- , $e\gamma$, $\gamma\gamma$ Optics for the initial Detectors
- ⋮
- ⋮
- etc

FIRST IMPORTANT STEP is
DETECTOR SIMULATIONS!

Detector Simulations

Program initiated at the June Boulder Mtg
Mike Peskin, Tim Barklow, Richard Dubois

1. Assemble detector simulation software package
2. Pick "Bell weather" Reactions that can be used to optimize detector performance. For example
$$e^+ e^- \rightarrow \tilde{\nu} + \tilde{\nu}^*, \quad \tilde{\nu} \rightarrow e^- \tilde{\chi}^+$$
etc.
3. Carry out simulations on a variety of detector designs

-
- Start organizing effort now
 - Introduce first version of software package and list of Bellweather reactions at KEYSTONE Meeting
 - Start Presenting initial results at the BARCELONA Meeting

Plans for the North American Linear Collider Detector Simulation Study---draft

At the recent Boulder meeting of the North American interim working group organizers for the linear collider detector project, one of the most important issues was that of how the detector simulation studies would be carried out. In this document, we would like to propose a very specific plan for the studies that will be done between now and the Barcelona international meeting. Our understanding is that this plan implements the decisions that were made in Boulder. Your comments and criticism are welcome.

-- Tim Barklow, Richard Dubois, Michael Peskin

General Structure and Philosophy

In order to formulate a detector configuration for the linear collider experiments, we need to understand how the various choices for the form of the detector affect the quality of the measurements that we will make. To address this question, we plan to choose a number of standard and nonstandard physics processes and to study, for each of these individually, the optimization of the detector. At this stage, the North American working groups do not feel it is important to fix a particular detector design concept or to carry out detailed studies that are specific to a fixed detector or machine design. Rather, we would like to obtain an overview of the merits, problems, and compromises in many possible design schemes. Our goal is not to bring a specific detector design to the Barcelona international meeting, but rather to bring a great deal of data that will make the discussion of design options concrete.

Our plan for accumulating this data is the following: During the summer, Richard will put together the detector simulation software package described below. This package will allow the creation of detectors with fairly arbitrary form, subject to the general constraint that these detectors have cylindrical symmetry and uniform solenoidal magnetic fields. (Truly novel detector ideas are welcome, but they fall outside the domain of this package.) The calorimetry in these detectors will be simulated in detail using the GISMO framework. Richard will provide an interface through which the simulated detector will receive high-energy physics events, a collection of generators which write events in the required structure, a simplified simulation of beamstrahlung and other machine-dependent effects compatible with these generators, and a set of specific detector configurations which can be used as examples.

We plan to have these tools ready to introduce to the community at the Keystone meeting at the end of September. We also plan to have one sample physics analysis done by that time, which can be posted as an example.

The work of obtaining an overview of the linear collider physics will be parceled out in manageable chunks to the members of our collaboration. To facilitate this, Michael will discuss with the working group leaders this summer to draw up a list of about twenty specific physics measurements, giving for each a set of specific questions about detector design. We expect that any group submitting an linear collider detector R & D proposal will also contribute manpower to answer one of these sets of questions before the Barcelona meeting.

It is our belief that this plan dovetails nicely with the ECFA/DESY linear collider study, which will

See our Web Page

<http://www.slac.stanford.edu/~tim/barklow/lincol.html>

THE TIME HAS COME

Anyone interested in getting involved in Future etc-Detectors can get started Now

1. Contact any of the Interim organizers for the Working Group(s) of interest

2. Contact Mike Peskin, Tim Barklow or Richard Dubois on simulations

3. Register for the Keystone Workshop

Applications accepted at this time

Meeting open to all

WE NEED TO START ASSEMBLING
PEOPLE FOR DETECTOR SIMULATIONS
SOON!