Program

Morning, Tuesday, October 24: Plenary Session: Invited Talks
Location: Auditorium

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
<th>Chairperson</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30am</td>
<td>Registration</td>
<td>Wilson Hall</td>
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</tr>
<tr>
<td></td>
<td>PHYSICS PERSPECTIVES</td>
<td></td>
<td>Chairperson: Enrique Fernandez</td>
</tr>
<tr>
<td>8:30am</td>
<td>Opening of the Workshop - Welcome</td>
<td></td>
<td>Mike Witherell (Fermilab)</td>
</tr>
<tr>
<td>8:45am</td>
<td>Charge to Participants</td>
<td></td>
<td>Sachio Komamiya (U. Tokyo)</td>
</tr>
<tr>
<td>9:15am</td>
<td>Theoretical Perspectives for LC</td>
<td></td>
<td>Peter Zerwas (DESY)</td>
</tr>
<tr>
<td></td>
<td>Physics of the LHC</td>
<td></td>
<td>Marjorie Shapiro (UC Berkeley and LBL)</td>
</tr>
<tr>
<td>10:55am</td>
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<td></td>
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<tr>
<td>11:55am</td>
<td>LINEAR COLLIDER STATUS REPORTS</td>
<td></td>
<td>Chairperson: Takayuki Matsui</td>
</tr>
<tr>
<td>11:15am</td>
<td>TESLA Linear Collider</td>
<td></td>
<td>Olivier Napoly (Saclay)</td>
</tr>
<tr>
<td>11:45am</td>
<td>NLC</td>
<td></td>
<td>Tor Raubenheimer (SLAC)</td>
</tr>
<tr>
<td>12:15pm</td>
<td>JLC</td>
<td></td>
<td>Yong Ho Chin (KEK)</td>
</tr>
<tr>
<td>12:45pm</td>
<td>CLIC</td>
<td></td>
<td>Ian Wilson (CERN)</td>
</tr>
<tr>
<td>1:15-2:15pm</td>
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<tr>
<td></td>
<td>LUNCH</td>
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Afternoon, Tuesday, October 24: Plenary Session: Invited Talks
Location: Auditorium
ASSOCIATED ACCELERATOR OPTIONS - I  
Chairperson: Charles Prescott

2:15pm  
What is the Case to Return to the Z-pole?  
Klaus Moenig (DESY)

2:50pm  
Machine Implications for Detectors  
Toshiaki Tauchi (KEK)

3:30pm  
BREAK

NEW THEORETICAL CHALLENGES - I  
Chairperson: Yasuhiro Okada

4:00pm  
Unscrambling New Models  
Bogdan Dobrescu (Yale)

ASSOCIATED ACCELERATOR OPTIONS - II  
Chairperson: Alvin Tollestrup

4:45pm  
Free Electron Laser- Scientific Goals and Machine Implications  
John Arthur (SLAC/SSRL)

5:30pm  
gamma-gamma, e-gamma, and e-e^- Options  
Tohru Takahashi (Hiroshima Univ.)

6:15pm  
SOCIAL HOUR at the Village Barn - Welcome Reception

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Morning, Wednesday, October 25: Parallel Sessions

8:30am - 12:00pm with 10:00-10:30am Break

<table>
<thead>
<tr>
<th>P1: Higgs, SUSY Higgs</th>
<th>P2: Top quark</th>
<th>P2': QCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1W</td>
<td>Location: WH1E</td>
<td>Location: WH7XO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D1: Detector Tools</th>
<th>D2: Interaction regions</th>
<th>D4: Muon detectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1N</td>
<td>Location: Curia II</td>
<td>Location: WH3NE</td>
</tr>
</tbody>
</table>

12:00-1:00pm  
LUNCH

Afternoon, Wednesday, October 25: Parallel Sessions

1:00pm - 4:00pm with 2:30-2:45pm Break

<table>
<thead>
<tr>
<th>P3: SUSY partners</th>
<th>P4: Electroweak</th>
<th>P5: New/Alternative Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1N</td>
<td>Location: Curia II</td>
<td>Location: WH1E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3: Vertexing &amp; Tracking</th>
<th>D5: Calorimetry &amp; Masks</th>
<th>D6: DAQ/Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1W</td>
<td>Location: WH7XO</td>
<td>Location: WH3NE</td>
</tr>
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</table>

Location: Auditorium
Invited Talk  NEW THEORETICAL CHALLENGES - II  Chairperson: Kaoru Hagiwara

4:00pm  Large Extra Dimensions
(in conjunction with Fermilab Colloquium)

N. Arkani-Hamed
(UC Berkeley and LBL)

5:00-6:00pm  Parallel Sessions resume as needed

6:00-7:00pm  Tours of CDF, D0, Minos, KTeV, A0, etc.

Morning, Thursday, October 26: Parallel Sessions

8:30am - 12:00pm with 10:00-10:30am Break

<table>
<thead>
<tr>
<th>P1: Higgs, SUSY Higgs</th>
<th>P2: Top quark &amp; QCD</th>
<th>P3: SUSY partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1W</td>
<td>Location: WH1E</td>
<td>Location: WH7XO</td>
</tr>
</tbody>
</table>

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<tr>
<th>D1: Detector Tools</th>
<th>D2: Interaction regions</th>
<th>D4: Muon detectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1N</td>
<td>Location: Curia II</td>
<td>Location: WH3NE</td>
</tr>
</tbody>
</table>

12:00-1:00pm  LUNCH

Afternoon, Thursday, October 26: Parallel Sessions

1:00pm - 4:30pm with 3:00-3:30pm Break

<table>
<thead>
<tr>
<th>P1: Higgs, SUSY Higgs</th>
<th>P4: Electroweak</th>
<th>P5: New/Alternativee Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1W</td>
<td>Location: Curia II</td>
<td>Location: WH1E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3: Vertexing &amp; Tracking</th>
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<th>D6: DAQ/Trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: WH1N</td>
<td>Location: WH7XO</td>
<td>Location: WH3NE</td>
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</table>

Location: Auditorium

Invited Talk  NEW THEORETICAL CHALLENGES - III  Chairperson: Torbjörn Sjöstrand

4:30pm  SUSY and the SUSY Breaking Scale
Rohini Godbole (IIS)

6:00pm  SOCIAL HOUR at Users' Centre - Cash Bar

Morning, Friday, October 27: Plenary Session: WG Summaries

Location: Auditorium
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairperson</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-9:15am</td>
<td>D1: Detector Simulation Tools</td>
<td>Norman Graf (SLAC)</td>
</tr>
<tr>
<td>9:25-10:10am</td>
<td>D2: Interaction Region: Masks, Background Rates</td>
<td>Tom Markiewicz (SLAC)</td>
</tr>
<tr>
<td>10:20-10:30pm</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td>10:30-10:50am</td>
<td>D4: Muon Detection and Particle ID</td>
<td>Marcello Piccolo (Frascati)</td>
</tr>
<tr>
<td>11:00-11:20am</td>
<td>D6: DAQ and Triggering</td>
<td>Patrick LeDu (Saclay)</td>
</tr>
<tr>
<td>11:30-12:15pm</td>
<td>P4: Electroweak Physics and Strong Gauge Int.</td>
<td>Wolfgang Kilian (Karlsruhe U.)</td>
</tr>
<tr>
<td>12:30-12:45pm</td>
<td>Group Photo</td>
<td></td>
</tr>
<tr>
<td>12:45-1:30pm</td>
<td>LUNCH</td>
<td></td>
</tr>
</tbody>
</table>

Afternoon, Friday, October 27: Plenary Session: WG Summaries

Location: Auditorium

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1:30-2:45pm</td>
<td>Panel Discussion</td>
<td>Maury Tigner</td>
</tr>
<tr>
<td></td>
<td>Lab. Directors' Comments and Discussion</td>
<td></td>
</tr>
<tr>
<td>3:00-3:45pm</td>
<td>Working Group Summary Reports</td>
<td>Sally Dawson</td>
</tr>
<tr>
<td></td>
<td>P2: Top/QCD and Top Quark Physics</td>
<td>Lynne Orr (U. Rochester)/Steve Magill (ANL)</td>
</tr>
<tr>
<td>3:45-4:00pm</td>
<td>BREAK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Invited Talk</td>
<td>Michael Peskin</td>
</tr>
<tr>
<td></td>
<td>EXPERIMENTAL CHALLENGES</td>
<td>Marco Battaglia (Univ. of Helsinki)</td>
</tr>
<tr>
<td>4:00-5:00pm</td>
<td>Precision Measurements of the Light SM Higgs</td>
<td></td>
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<tr>
<td></td>
<td>Working Group Summary Reports</td>
<td>Choong Sun Kim (Yonsei)</td>
</tr>
<tr>
<td>5:15-6:00pm</td>
<td>P5: New and Alternative Physics</td>
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<tr>
<td>7:00pm</td>
<td>Conference Dinner at Naperville Hilton</td>
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Morning, Saturday, October 28: Plenary Session: WG Summaries

Location: Auditorium
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairperson</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-9:15am</td>
<td>D3: Vertexing and Tracking</td>
<td>Ron Settles</td>
<td>Jim Brau (U. Oregon)/Ties Behnke(DESY)</td>
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<td></td>
<td></td>
<td></td>
<td>Klaus Desch (Hamburg U.)/Yasuhiro Okada (KEK)</td>
</tr>
<tr>
<td>9:30-10:30am</td>
<td>P1: Higgs and SUSY Higgs</td>
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</tr>
<tr>
<td>10:45-11:00am</td>
<td>BREAK</td>
<td>Keisuke Fujii</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Working Group Summary Reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00-11:45am</td>
<td>D5: Calorimetry</td>
<td></td>
<td>Jean-Claude Brient (Ecole Polytechnique)</td>
</tr>
<tr>
<td>11:55-12:35pm</td>
<td>P3: Supersymmetry and Superpartners</td>
<td></td>
<td>Hans-Urlich Martyn (RWTH Aachen)</td>
</tr>
<tr>
<td>12:45-1:45pm</td>
<td>LUNCH</td>
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</table>

**Afternoon, Saturday, October 28: Plenary Session: Conference Summary**

**Location:** Auditorium

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chairperson</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:45-2:30pm</td>
<td>Conference Summary</td>
<td>Francois Richard</td>
<td>Paul Grannis (SUNY Stony Brook)</td>
</tr>
</tbody>
</table>
TESLA Linear Collider: Status Report

O. Napoly, CEA/Saclay

for the TESLA collaboration

OUTLINE

- Generalities
- SC Cavities and RF systems
- SASE-FEL
- Collider design
- Interaction Regions
- Conclusions
SC Cavities and RF Systems

TESLA Test Facility (TTF) Goals

Phase I
- Accelerator modules: from R&D to Industry

1991 costs: \( 200 \text{ k}$/$m \div 5 \text{ MV/m} = 40 \text{ k}$$/$MV

\[ \downarrow \quad \downarrow \quad \downarrow \]

2000 costs: \( 50 \text{ k}€/$m \div 25 \text{ MV/m} = 2 \text{ k}€/$MV

- SASE FEL at low wavelength (\( \sim 60 \text{ nm} \))

Phase II
- SC Linac up to 1.2 GeV

- SASE FEL User Facility (6 nm)
Accelerating gradients of 9-cell cavities

- Third production
- Second production Average: 24.7 MV/m
- First production Average: 20.5 MV/m

Number of cavities

LEP-I  LEP-II  CEBAF  TTF  E_{acc}  TESLA

Lutz Lilje, DESY

10.10.2000
Yield of cavities from CW test

Lutz Lilje DESY

10.10.2000
Conclusions

- TESLA Linear Collider designed for
  - $\sqrt{s} = 500-800 \text{ GeV}$ and $L = 3-5 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$

- TTF has overcome 2 major challenges:
  - Accelerating Module for 500 GeV with present level of technology from industry
  - SASE-FEL demonstrated below 100 nm

- R&D programme toward higher gradients is progressing:
  - $E_{\text{acc}} > 35 \text{ MV/m}$, $Q > 5 \times 10^9$ by electropolishing
  - 800 GeV LC requires better stiffening and filling factor (superstructure)


- Evaluation/German Wissenschaftsrat in 2001
  - Aim for start of construction as international project in 2003
NLC - The Next Linear Collider Project

The NLC Design

Linear Collider Workshop 2000
FNAL
October 24th, 2000

Tor Raubenheimer
NLC Design Changes

- Focused on cost reduction over last year – expect 30% reduction
- Many RF system improvements
- Facility length reduced by 20%
- Hi/Lo energy IR scheme and BDS redesign to optimize and open future expansion possibilities
- Investigating 180 Hz operation
- Technology based on results from test facilities: FFTB, NLCTA, ASSET, KEK ATF and knowledge gained from SLC operation
NLC Project Scope

- **Injector Systems**
  - 1.5 TeV

- **Main Linac**
  - Housing with all internal services
  - Half filled for initial 500 GeV cms
  - Upgrade by adding rf, water, power to the 2nd half of the tunnels
  - 0.5 - 1.0 TeV

- **Beam Delivery (high energy IR)**
  - Two BDS tunnels and IR halls with services
  - Some magnet strengths must be increased to get from 1 TeV to 1.5 TeV
  - 1.5 TeV

(1.5 TeV with increased gradient or length)

(length will support a 5 TeV FFS)
Stage 1: Initial operation  
500 GeV cms  
$L = 5 \times 10^{33} \rightarrow 20 \times 10^{33} \Rightarrow 500 \text{ fb}^{-1}$

Stage 2: Add additional X-band rf components  
1 TeV cms  
$L = 20 \times 10^{33} \rightarrow 30 \times 10^{33} \Rightarrow 1000 \text{ fb}^{-1}$

Higher Energy Upgrades:

- 1.5 TeV with upgrade of linac rf system or length increase  
  - injector and beam delivery built for 1.5 TeV
- 3 TeV+ with advanced rf system and upgraded injector  
  - see CLIC parameters: “A 3-TeV $e^+e^-$ Linear Collider Based on CLIC Technology,” CERN-2000-008
  - beam delivery sized for 3 to 5 TeV collisions
Hi/Lo IR Layout

Site roughly 26 km in length with two 10 km linacs

Possible staged commissioning

Low energy IP
92-350 (500??) GeV

Low energy (50 - 175 GeV) beamlines

E+ E-

Multiple beams line might share main linac tunnel

Centralized injector system possibly for TBA drive beam generation also

High energy IP
0.25-5.0 TeV upgraded in stages
Summary

- Lots of progress on NLC design in last year!
- Lehman review positive but cost was too high!!

- Continual improvement in rf components $\Rightarrow$ cost reductions
- More aggressive approach to design $\Rightarrow$ cost reductions
- New concepts $\Rightarrow$ cost reductions
- Lots of ideas for further improvements

- Expect $\sim 30\%$ cost reduction with further reduction possible from additional R&D and/or scope reduction

- NLC is designed for high luminosity (similar to TESLA) *however* neither design has much margin at these parameters
- NLC facility will be designed to support a future multi-TeV LC
STATUS OF CLIC STUDIES

Ian Wilson

LCWS 2000 FERMILAB
24th October 2000
Collider has been optimized for 3 TeV with $L = 10^{35} \text{ cm}^2 \text{ s}^{-1}$

Designed such that construction can be staged without making major mods.

First stage would possibly be HIGGS Factory at 0.5 TeV with $L = 10^{34} \text{ cm}^2 \text{ s}^{-1}$

Second stage would provide the very desirable $e\pm$ data $\approx 1.5 \text{ TeV}$ to complement the p-p data from LHC, and at 3 TeV we should be breaking new ground.

Final stage would be 5.0 TeV with $L > 10^{35} \text{ cm}^2 \text{ s}^{-1}$
Coherent Pairs

<table>
<thead>
<tr>
<th>$E_{GM}$ [TeV]</th>
<th>no of pairs</th>
<th>$E_{coh}$ [$10^9$ GeV]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>700</td>
<td>$10^{-2}$</td>
</tr>
<tr>
<td>1</td>
<td>$3 \cdot 10^6$</td>
<td>0.8</td>
</tr>
<tr>
<td>3</td>
<td>$6.7 \cdot 10^8$</td>
<td>440</td>
</tr>
<tr>
<td>5</td>
<td>$1.8 \cdot 10^9$</td>
<td>1630</td>
</tr>
</tbody>
</table>

$\Rightarrow$ significant fraction of bunch charge ($1 \cdot 10^8$)

$\Rightarrow$ exit angle larger than 10 mradian
RF BREAKDOWN OF ACCELERATING STRUCTURES

RF breakdown has been observed in both the NLC/JLC and CLIC prototype accelerating structures at gradients below the nominal values.

Special workshop organised at SLAC in September to discuss problem.

Conclusion (if there was one) : just don’t understand the physics which initiates and sustains RF breakdown - more detailed studies clearly needed to investigate effects of : material, geometry, and cleaning and RF conditioning procedures.

The situation for CLIC is as follows.

In 1994 before we had 30 GHz power source we built a 26 cm 11.4 GHz low-group-velocity structure and tested it at SLAC to peak gradient of 154 MV/m (125 MV/m average) with 150 ns pulse length.

So here is a proof of existence of the very high gradients we are aiming for.

So what about the breakdown and damage observed in the CTF2 ?

Damage has been observed at relatively low gradients (60 MV/m) – so there is clearly a problem BUT we do not consider these results to be representative of what we can finally achieve. Why ?

(i) Damage confined to the input coupler which has a 40% over-voltage enhancement - can be taken out by modifying the design – this is foreseen.

(ii) Structures were exposed to air (and dust) for about 6-7 years and were operated under unusually poor vacuum (perhaps as bad as 10^-3 torr).

(iii) Structures were conditioned using aggressive conditioning procedures and with a limited number of pulses (CTF2 only runs at 5 Hz!).

Have to wait for new round of high gradient tests on structures with an improved coupler design and better vacuum conditions before we can really say if we have a serious problem or not.
3T Detector

3T detector with reduced W mask

CDC

~2 hits/BX by $\gamma$

~2 hits/BX by $n$

155 cm → 205 cm

Endcap CAL

_w Mask

Compensation Mag.

CH$_2$ Mask

100 cm → 200 cm

QC1

223 mrad
Impact of the new optics ($l^* = 4.3\text{m}$) on the detector

- Huge W-mask NOT needed
- Background hit much smaller (CDC, CAL)
- No need for Support tube (?)
- No need for Compensation magnet (?)
  if the B field @4.3m is weak enough
- Smaller $R_{\text{min}}$ of CDC and CAL possible
Topview of Test Beam and Fixed Target Areas

Not to scale
The LEP Spectrometer

Near LEP IP3, we installed (in 1999):

- Quad
- Wire Position Sensors
- Steel Dipole
- Synchrotron Absorbers
- BPM Pickups
- NMR Probes
- 0m
- 10m

Available space dictated $\theta = 4.8$ mrad, Lever arm $\sim 10$ m:

- BPM Resolution in bending plane $\Rightarrow \delta x_{BPM} \sim 1 \mu m$
- Stability required for a few hours only
- BUT must be stable as machine energy doubles

Beam Pickups
- Mechanical and Thermal stability
- Precise and Stable Electronics

Capacitive Wire Position Monitors
- Independent Position Monitoring
- Limit Rotations of Triplet Arms

Magnet System
- Well-Behaved Steel Dipole
- NMR Instrumentation
- Precision Field Map
1. Physics capability at ~ 500 GeV -- highlights
2. Special operating conditions
3. What energy/luminosity will we ultimately need?
4. Some scenarios
5. How does the world community proceed?

A necessarily telegraphic tour through the many results shown here, focussing on some more general issues. The views are mine, and of course can be argued with! The many good results and ideas are yours!
## Linear ee Colliders

(Napoly, Raubenheimer, Chin, Wilson, Tauchi, Markiewicz)

<table>
<thead>
<tr>
<th></th>
<th>TESLA</th>
<th>JLC-C</th>
<th>NLC/JLC-X *</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_{\text{design}}$ ($10^{34}$)</td>
<td>3.4  →  5.8</td>
<td>0.43</td>
<td>2.2  →  3.4</td>
</tr>
<tr>
<td>$E_{\text{CM}}$ (GeV)</td>
<td>500  →  800</td>
<td>500</td>
<td>500  →  1000</td>
</tr>
<tr>
<td>Eff. Gradient (MV/m)</td>
<td>22   →  35</td>
<td>34</td>
<td>50</td>
</tr>
<tr>
<td>RF freq. (GHz)</td>
<td>1.3</td>
<td>5.7</td>
<td>11.4</td>
</tr>
<tr>
<td>$\Delta t_{\text{bunch}}$ (ns)</td>
<td>337  →  176</td>
<td>2.8</td>
<td>1.4</td>
</tr>
<tr>
<td>#bunch/train</td>
<td>2820  →  4886</td>
<td>72</td>
<td>190</td>
</tr>
<tr>
<td>Beamsstrahlung (%)</td>
<td>3.2  →  4.4</td>
<td></td>
<td>4.6  →  8.8</td>
</tr>
</tbody>
</table>

$\mathcal{L} = 10^{34}$ cm$^{-2}$s$^{-1}$ for $10^7$ sec. year
gives 100 fb$^{-1}$ per year

* US and Japanese X-band R&D cooperation, but machine parameters may differ

- **TESLA**: Design report spring 2001; German funding decision ~ 2002?
- **NLC**: aim complete R&D for Design Rept 2003
- **JLC**: set milestones end 2000: Design Rept ~2003

**CLIC**: multi-TeV, 30 GHz, 150 MV/m gradient with drive beam power source in R&D phase
How does the world community proceed?

(this is a personal point of view, colored by the U.S. outlook - but we need to engage these issues as a world community over the coming year.)

1. Timelines:
   - We expect Tesla design report in spring 2001; decision 2002?
   - Japan JLC proposal in few years
   - US NLC R&D over next 2-3 years leading to proposal
     All 3 regions conducting studies of physics priorities for next ~20 years during coming year.

Alternate new projects:
- $\mu$ Storage Rings could only be ready for decision ~2010;
- $\mu$ Collider or multi-TeV ee collider only much later in that decade;
- VLHC needs physics input from LHC/LC and development of cost-effective magnets.
- Very large underground laboratories

CERN is evaluating its future beyond LHC
2. Should the LC be the next world machine at high energies?

- I believe it is inevitable that the LC decision is the next that must be taken by the worldwide community. We are developing real proposals in the very near term. Potential alternatives are much further in the future.

- It may be that not all regions will propose a LC in their region, or it may be that we will not convince governments to supply the funding needed. But we will reach a decision soon.

- We should expect at most one linear collider in the world.

- Worldwide support for the LC concept (somewhere) will be essential if it is to succeed. Arguing against the LC will likely not enhance the prospect for a subsequent large project.

- Particularly in the US community, we must engage the LC question, and consequence of opting for other paths. Snowmass 2001 affords the chance to confront as a community.

- LC should not be the last frontier accelerator in the world! There is room - and need - for coherent international planning.
How do we proceed?

3. Is the Linear Collider too expensive?

- One hears, particularly in the US, that the likely cost of the LC is too large to sell to the government.
- I believe that ANY future collider of any of the types we have been discussing falls into at least comparable cost categories. So, this issue is not for the LC alone, but is endemic to HEP future progress.
- The cost of the LC is seen by some as the primary driver toward the initial stage at ~500 GeV. They ask: “Will such a stage address the crucial next questions?”

  The question of where EWSB comes from is the most crucial question before us - and we are confident that the 500 GeV LC will give us powerful understanding of how it works. We believe that the LHC will not give us full understanding. It is likely that upgrades to the LC will be needed in future, but the first phase is the best bet we can make to provide windows to tell us where to go next.

- Cost is a factor, and we must press all ways to control it. But we must not lose sight of the probable need for future evolution in the design.
4. Where will the LC be?

- Most adherents of a LC say that they want this machine, and are happy for it to be anywhere in the world. But, I suspect that what this usually really means is that they want it in their region, with substantial contributions from other regions.

- It seems likely that in fact the strongest factor for siting the LC will be a decision by one region to pay most ($\sim 2/3$?) of the cost.

- The LC had better be a worldwide collaboration, both for machine and for detectors. We are entering an era of very few accelerators, and the health of HEP in all regions requires that we all participate strongly in each. The corollary of this is that each region has a strong need for some frontier collider in their region, to keep the regional community strong.

- We need some global planning to keep this balance alive. Should envision some synthesis of the present planning exercises.

- In the near future, Europe will take the energy frontier with the LHC. Asia and North America will need to develop future facilities.
How do we proceed?

5. We need to further develop internationalism in HEP accelerator projects

5. Internationalism means making new compromises – for example, if the LC is in one region, it will be desirable that the other regions play major roles.

6. The development of the 'international control room' and more generally, the full collaboration in design, building, operating the collider, is very important. Each region needs major accelerator projects to keep its machine scientists engaged and productive.

We might envision that major portions of the LC - injector & damping rings; rf delivery and main linac; final focus and beam delivery; etc - could well be the responsibility of different regions from design to operation. The global accelerator concept should be developed to facilitate this decentralization.

5. This globalization of the accelerator will be tough! An accelerator project needs to be controlled at a tighter level than the international detectors we have built so far. The globalization should be built into the projects from the start. Making the physics case and detector designs should be inter-regional.
6. Technical Evaluation of LC proposals

- There has been discussion of a worldwide panel to evaluate the machine technical proposals (not approval or site issues). The aim would be to try to have some common framework for looking at the performance parameters, the R&D needs and the technical risks. Cost assessments should be made in defined frameworks. We should understand issues related to upgradability in energy and luminosity, or application to two beam drive upgrades for the different proposals.

- We should welcome the Directors’ endorsement of such a review; it will give the world community an equal footing comparison, and will clarify the choices we must make.

- Drafting the charge, setting the committee, and finding the appropriate responsible body will be delicate. ICFA should play here, but the issues involved connect to us all. There needs to be involvement of bodies representative of the broad community -- EPS, JPS, APS, IUPAP ...
Conclusion

The physics case for the LC with a 1st stage at ~ 500 GeV is very strong. We need a linear collider to study EWSB in any scenario. We know enough to make the choice now.

With present lack of understanding of how EWSB is manifested, flexibility of Linear Collider design (energy, , beam particles) is essential. The LC will be an evolving facility.

The cost will be high. Unless we internationalize so as to satisfy the needs of all regions and allow productive collaboration, we jeopardize the prospect of the LC, or any other new frontier facility anywhere.