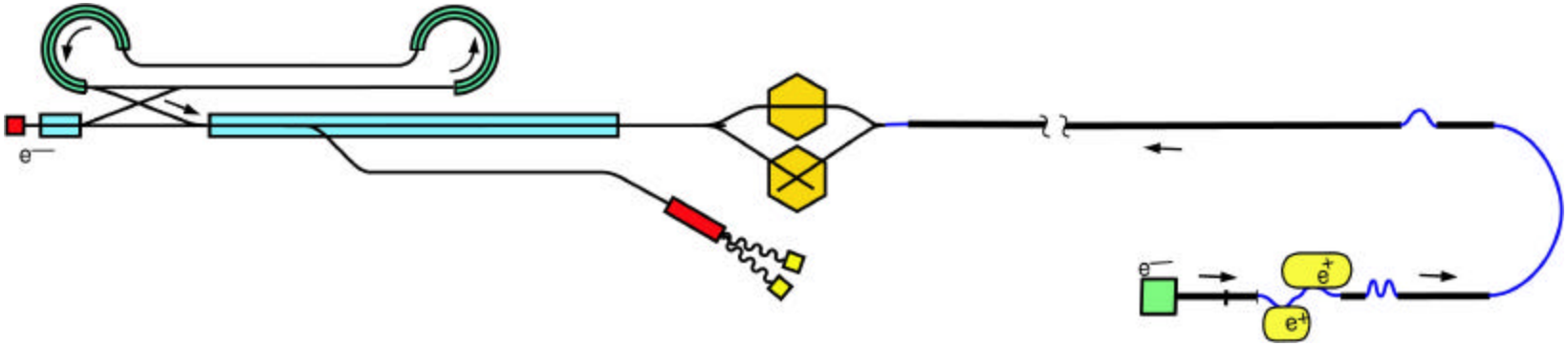
2001 Technical Review Committee



Nan Phinney

NLC MAC meeting

Fermilab

May 12, 2002

TRC Original Charge (1994)

"The Technical Review Committee ... is to examine accelerator designs and technologies suitable for a collider that will initially have center-of-mass energy of 500 GeV and luminosity in excess of 10^{33} $cm^{-2}s^{-1}$, and ... can be expanded in energy and luminosity to reach 1 TeV center-of-mass energy with luminosity of 10^{34} $cm^{-2}s^{-1}$.

... comment on the potential ... to reach higher energies and luminosities, and to provide alternative physics capabilities, for example gamma-gamma collisions.

... attempt to identify areas of possible further collaboration in the world-wide linear collider R&D program.

A draft of the Committee report should be submitted to the Collaboration Council shortly after the LC 95 meeting scheduled for March 1995 in Japan."

2001 ICFA Charge

In Feb, 2001, ICFA requested a 2nd report

to reassess the linear collider designs still in the running

with the energy goal of 500 GeV in the center-of-mass and luminosity of the order of $10^{34}/cm^2/s$.

The assessment must also include potential extendibility to 1 TeV or higher energy.

The technical approaches to be examined are:

a) TESLA
b) JLC (C-band)
c) JLC (X-band)/NLC (X-band)
d) CLIC

ILC-TRC Steering Committee

Chair:	Gregory Loew (SLAC)
Members:	Reinhard Brinkmann (DESY)
	Gilbert Guignard (CERN)
	Tor Raubenheimer (SLAC)
	Kaoru Yokoya (KEK)

1st meeting - Snowmass 2001

Established guidelines for the overall descriptions of the machines and created two working groups.

1) Technology, RF Power and Energy Performance
2) Luminosity Performance

Charge to Working Groups

1) Technology, RF Power and Energy Performance Group

... analyze all factors which affect the energy performance [including] sources, injectors, magnets, cryogenics, klystrons, power supplies, modulators, rf pulse compression systems, rf amplitude and phase stability, and any other parts of the designs which determine whether the machines can reliably reach their operating energy, be tunable, and efficient in their use of electric power.

2) Luminosity Performance Group

... analyze all those factors which affect the ultimate luminosity performance (both peak and integrated), including ... emittance dilution, beam jitter, tunability, and reliability. ... predict the final emittances and luminosity reachable at the interaction point. ... set common standards and use common computer codes to predict emittances, jitters, etc. ... [including] mechanical and electrical tolerances, ground motions at various sites.

TRC Working Groups

NLC

Energy & Technology

Daniel Boussard (Chair)

Chris Adolphsen, SLAC
Hans Braun, CERN
Yong-Ho Chin, KEK
Helen Edwards, FNAL
Kurt Hubner, CERN
Lutz Lilje, DESY
Pavel Logatchov, BINP
Ralph Pasquinelli, FNAL
Marc Ross, SLAC
(Tsumoru Shintake, KEK)
Nobu Toge, KEK
Hans Weise, DESY
Perry Wilson, SLAC

Luminosity

Gerald Dugan (Chair)

Ralph Assmann, CERN
Winnie Decking, DESY
Jacques Gareyte, CERN
Witold Kozanecki, Saclay
Kiyoshi Kubo, KEK
Nan Phinney, SLAC
Joe Rogers, Cornell
Daniel Schulte, CERN
Andrei Seryi, SLAC
Ron Settles, MPI
Peter Tenenbaum, SLAC
Nick Walker, DESY
Andy Wolski, LBNL

sub-Working Groups

Each formed 5 sub-groups (leaders and members assigned)

Luminosity group

1) Sources	(Decking)
2) Damping rings	(Rogers)
3) Low emittance beam transport (DR–> IP)	(Schulte,Tenenbaum)
4) Collimation, Backgrounds, Detector Interface	(Kozanecki)
5) Reliability & Operability	(Phinney)

Energy and Technology group

1) Structures	(Wilson)
2) Power sources	(Chin)
3) Power Distribution	(Hubner)
4) Injector and Beam Delivery Systems Technology	(Weise)
5) Reliability	(Pasquinelli)

Proposed Timetable

July 2001	Official proposal to ICFA
October 2001	Steering Committee provides Project Descriptions and Tables of machine parameters
February 2002	1st full TRC meeting, LC 2002 @SLAC
April 2002	2nd full TRC meeting, CERN
June 2002	Partial draft of Report, TRC meeting, EPAC, Paris
October 2002	Final Report ready

Present status:

DRAFT Tables & project descriptions done for all (as of 10 Apr)
WGs and sWGs have held several video and phone meetings
Simulations underway for Damping Rings, and DRs –> IP, Backgrounds
Early drafts of some luminosity and energy chapter sections
Plan to have drafts of most sections by June (with some holes)

Report Outline

- Executive Summary
  - Charge, membership, etc.
- Project Descriptions
  - TESLA, JLC-C (linac rf), NLC/JLC-X, CLIC
- Test Facilities (past & future)
- Working Group assessments
  - Technology, RF power & Energy Performance
  - Luminosity Performance
  - Reliability and Operability (joint)
- Future R&D (requirements & timescale)
- Opportunities for future collaboration

1994 vs 2001 TRC

1994 TRC documented status of existing designs
- based on information from projects
- little attempt at evaluation

2001 TRC is to make a "critical assessment" of designs
- evaluate status of each project
- identify strengths & problem areas
- indicate required R&D
- includes new studies of DRs, linac–> IP, backgrounds

TRC will provide guidance to the community

It is NOT making a "Technology Choice"
- but will judge viability/readiness of projects

Some 2001 TRC Groundrules

Baseline energy is 500 GeV - Upgrade energy is
  800 GeV (TESLA), 3 TeV (CLIC), 1 TeV (others)

JLC-X and NLC have common parameters
  NLC optics to be used for simulations (DRs, linac, FF)
  JLC main linac rf configuration evaluated separately

JLC-C has only main linac rf considered
  no description provided for rest of machine

CLIC has linac and beam delivery design for 500 GeV
  no damping ring design provided

TESLA and NLC have engineering & reliability studies
  others very little except for rf or drive beam

Major NLC Effort in 2002

NLC/JLC X-band description, test facilities

Raubenheimer with input from JLC, ATF

Linac –> IP simulations

Tenenbaum, Seryi, Woodley, Hendrickson - working full time with help from Wolski (LBNL), ARDA physicists

Damping Ring simulations

Wolski has studied NLC and TESLA in depth

Main linac RF

Adolphsen, Wilson, Ross with help from RF groups

Reliability and Operability

Pasquinelli (FNAL), Phinney, Ross with help from NLC engineers tuning impact estimates by DR and Linac simulators

Main Linac RF

- Both TESLA and JLC/NLC have technology close to required for 500 GeV initial stage
  - 23 MV/m SC cavities, ~50 MV/m X-band structures
  - more lifetime testing, etc. needed
- Energy upgrade requires higher gradient structures from start to avoid costly replacement later
  - 35 MV/m SC cavities, 70 MV/m X-band structures
- High power tests of full gradient structures in 2003-04
  - 35 MV/m module @ TTF2 + ~25 MV/m modules
  - '8-pack' @ NLCTA - modulator, 8 klystrons, DLDS, structures
  - JLC-X also plans '4-pack' test, JLC-C building Spring-8 Linac
  - CTF3 drive beam test slightly later (~2005)
    - lifetime testing, operational experience also important

Simulation results

Critical look by outside experts indicates all projects have areas that need more work

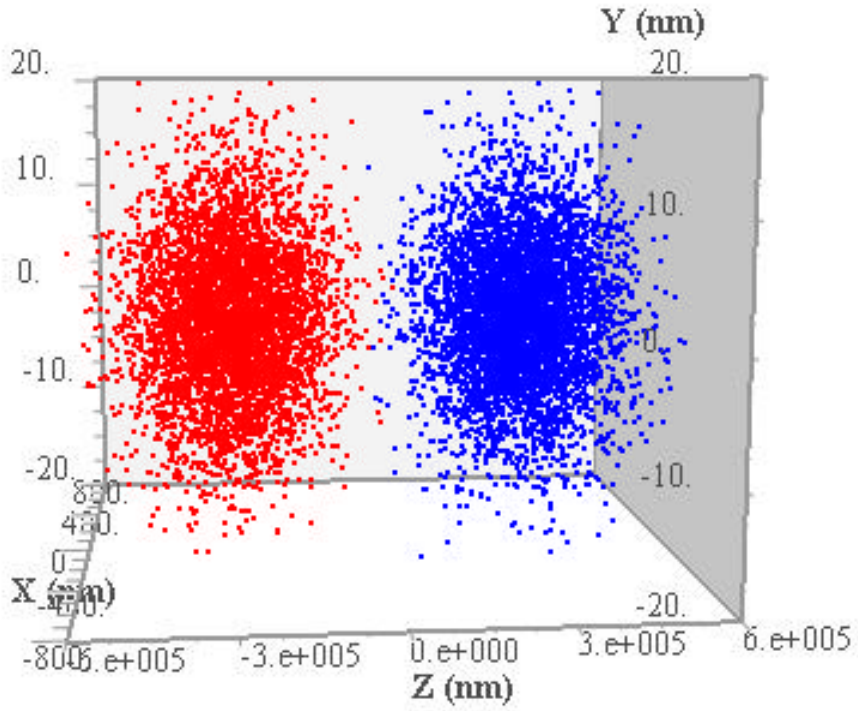
Damping Rings

- TESLA wigglers redesigned, present tuning algorithms don't work
- Collective instabilities (Fast Ion, Electron Cloud) a concern for NLC/JLC & TESLA - preventive measures indicated

Low Emittance Transport (DR –> IP)

- 'cradle-to-grave' simulations indicate potential sensitivities
- problems with TESLA bunch compressor tuning & tolerances
- Alignment tolerances in SC cavities (systematic offsets, tilts) may indicate better diagnostics needed
- 'Banana' effect can reduce gain from disruption enhancement TESLA may shorten bunches, less important for NLC/JLC

Beam-Beam Interaction



Pre-Snowmass studies by
- Napoly (Saclay)
- Schulte (CERN)
- Brinkmann (DESY)

show sensitivity to offsets, distortions, etc.

Integrated simulation of Linac with Final Focus required to see effects

Methods to mitigate luminosity loss under study

Summary

TRC report will NOT choose a technology

- but indicate strengths/weaknesses/areas needing work

Each project will benefit from critical assessment

- potential problems identified - solutions developed

Most Important Outcome

- experts learn details of alternate designs
- collaborative simulation work will continue after TRC
- new opportunities for collaboration will be identified and hopefully pursued (e+ production, collimation, IR design)

If the Linear Collider is a truly International Machine, the TRC effort can be an excellent 1st step to building the Collaboration we need