North American Linear Collider Group

Update on LC Activity
(and Welcome to LoopFest II!)

- Why you are important
- LHC developments pertinent to you
- The emerging Linear Collider activity
- The US LC scope paper
- Update from the recent ECFA-DESY meeting
- International developments
- CERN's LC role
- Future LC meetings

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You are important!

- I'm not joking – the physics of TeVatron, LHC and LC depends crucially on getting better background understanding, K-factors, new physics generators
- LEP ushered in a new standard of gestalt understanding of physics and backgrounds
  - But even there we did not go far enough (e.g., ISR/FSR…)
  - Data/MC mismatches: new physics or bad generators?
  - See Graham Wilson's LoopFest I talk for motivation, and Tim Barklow's talk at this workshop
- As we stand near the precipice of the expected new physics (Higgs), are we ready to step forward?
  - Sufficient machinery lacking for LC
  - Previous pun was intentional ☺

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New Resources

- LHC is changing the scene for everyone
- GRID computing is facilitating event generation like never before, and TeVatron & LC use it too
- New detectors are redefining how we might look for the physics (e.g., energy flow) … and the generator designers need to understand the new tools

- How can the generator effort get more support?
  - Loopverein working groups?
  - The LHC/LC international groups are a good start
  - This is something for you to discuss at dinner!
    - Why isn't there a Loopverein proposal to LCRD?

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Emerging LC Activity

- Snowmass 2001 and the HEPAP roadmap gave LC the US mandate
- The German government has announced (some) support for international LC activity
- The Asian community announced serious planning in February
- An International LC Steering Committee has been established as an official arm of the Worldwide LC group, and it is now taking serious steps:
  - Political & organizational planning
  - Technology choice
  - Outreach
- … and there is emerging US support for LC

Wagner updated us on the status of LC in Germany

Future Direction fo

Community will now take the other path used for internatior projects (e.g. ITER):

- unite first behind one project with all its aspects, includir technology choice, and then
- approach all possible governments in parallel in order to tr the decision process and site selection.

Important to note: The statement by the German governme

- is positive on a linear collider in general,
- approves continued R&D on TESLA,
- encourages the German participation in a global project,
- but leaves the site selection open for the time being.

Albrecht Wagner, DESY

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Regions and Issues

- To facilitate basic actions, 3 regions: America (HEPAP), Asia (ACFA), Europe, new and old (ECFA)
- These regional groups will decide what LC they want
- ILCSC will create machinery to link the 3 regions and make choices (ILC-TRC) and take political actions

- The “scope papers” are the requisite white papers needed to justify a new machine
  - The American paper has been issued
  - Europe’s is underway
  - An ILC committee has been established to unify them

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The USLCSG Scope Paper

"Design Considerations for an Int'l LC"

(http://blueox.uoregon.edu/~lc/scope.ps)

What the document accomplishes

- Document Structure
- Initial Energy and Luminosity
- Ultimate Energy
- Polarization
- Interaction Points
- Z running
- Collision Options
- Machine-Detector Issues

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Intent of the Scope Paper

- In June the USLCSG asked that the ALCPG write a white paper describing the physics-motivated machine parameters …
  - A document the machine planners can start using now
  - A document to define the goals before funding agencies

- The Executive Committee used the "Orange book" and input from the working groups to:
  - define the minimal acceptable parameters
  - prioritize options
  - not really to be used to choose technologies

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Document Structure

- brief (12 pgs) and to the point
- summarizes the physics driving the parameters
- does not suggest a technology choice
  - … and no parameters suggest one
- Difficult issue:
  - Phase-II energy:
    - > 1 TeV GeV

Physics Intro	Machine-Detector Issues
Initial Energy and Luminosity	Z Running
Beam Polarization	Energy upgradeability
IP Configurations	Collision Options

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Initial Energy and Luminosity

- Initial Energy: 200-500 GeV at 2×10^{34} $cm^{-2}s^{-1}$
- ··· actually, we also state this in integrated lumi
  - Higgs:
    - Precision EW Higgs range m_h=115-200 GeV
      - peak energy suggests E ~ 400 GeV
    - H self-coupling: need ~ 500 GeV
    - WW fusion production requires 500 GeV
    - 5% Statistics for precision measurements
    - threshold scan requires longer run
  - SUSY:
    - pair production grounds for emphasizing 500 GeV and higher
  - Extended Models
    - Same luminosity serves well in large class of models
  - Polarization:
    - 80% on e^- initially (?) Positron polarization later???

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Ultimate Energy

- Controversial, but we must address this
- I think all of us are convinced ≥1 TeV is required
  - SUSY spectra in many benchmarks
  - Current views on SSB from lattice calculations
  - Higgs self coupling is a must-do!
  - MSSM Higgs spectra
  - Dynamical SB scenarios are high-energy scale
- For self-coupling: need *large integrated luminosity* too
- The LC will be the *frontier machine* after LHC
  - we make a strong case for E upgrades/longevity
  - table of physics-return versus E and integrated lumi
- Thus, a case is be made for > 1 TeV upgrades

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Interaction Regions

- We make the case for 2 interaction halls
  - The obvious benefits from 2 detectors
    - cross checking; competition; broader physics; specialization
  - Functionality of LC role in HEP community
  - Necessary for $\gamma\gamma$, e^-e^- options
  - Impact: crossing angle
    - this is a big point for us
    - we feel good beam diagnostics require angle

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Z Running

- Calibration: This is one of the debated points!
  - How much calibration running is necessary at the Z?
  - Good calibration essential for precision EW
  - Is this an absolute requirement? How much?
  - Working Groups: now is the time for more work!
- Giga-Z remains an upgrade option
  - depends on what new physics is discovered
  - Not discussed at length
- Despite uncertainties, a scenario for Z-pole running must be there!

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Collision Options

- We discuss the highly desirable options $\gamma\gamma$, e^-e^-
  - Strongly endorsed and impacts IP design
  - Physics:
    - Production cross sections
    - $H\gamma\gamma$ coupling
    - Measure CP assignments
    - Rare decays
    - Sensitivity to extended models

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How Machine Parameters Affect the Detector

- Crossing angle:
  - Beam instrumentation possible or greatly enhanced
    - Average energy measurement
    - Polarization measurement
    - Beam halo and stay-clear affect detector
- Beamstrahlung:
  - Warm/cold really pretty similar here
  - argument of larger e^+e^- background not compelling
- Bunch structure and timing:
  - Warm/cold have major difference in duty cycles, readout time.
  - Pros and cons for both technologies;
    - probably no showstoppers

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The Next Steps

- The ALCPG Executive Committee reviewed 5 drafts
  - Exec Ctte, WG leaders, USLCSG signed off on it in April
  - Now it is a public document stating the US position
- A World-wide LC white paper “Understanding Matter, Energy, Space and Time: The Case for the e+e- Linear Collider” was issued by a committee of the International LC SG
  - Very different purpose than our scope paper
  - Describes the situation in very general terms
  - Also garners support for the international effort by showing support of HEP physicists
  - Sign http://flc25.desy.de/lcsurvey !!!
- European and asian scope papers needed now

Understanding Matter, Energy, Space and Time : The Case for the e^+e^- Linear Collider

A world-wide consensus has formed for a baseline LC proje
which *positrons* collide with *electrons* at energies up to 50
with *luminosity* above 10^{34} $cm^{-2}s^{-1}$.

The energy should be upgradable to about 1 TeV.

Above this firm baseline, several options are envisioned wh
priority will depend upon the nature of the discoveries mad
the LHC and in the initial LC operation.

Albrecht Wagner, DESY

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NEWS from Amsterdar

The group formerly known as ECFA-DESY held its semiannual meeting recently

About 210 registered participants
About 20 from US and Canada

European Scope 1st round (from Amsterdam)

LC Scope: European Viev

1- Scope document should define a parameter set fo
Linear Collider to be used as the European input t
world wide scope discussion (ILCSC)

2- World wide agreed scope document (parameter s
as input to the 'wise person' panel

3- Parameter set to be justified by physics argument

4- 0th draft distributed before this workshop as basis
today's discussion

Draft distributed to ECFA/DESY

Phase 1

a) cms energy range 91 to 500 GeV
Justification: light Higgs self-coupling

b) at 500 GeV a design luminosity of 3.4*10^34/cm2/s and reliability suff
to deliver some 500 fb-1 in the first 4 years of running
Justification for int.lumi: light Higgs Boson properties
top quark studies
SUSY scans
Question: what to state concerning instantaneous lumi?

c) Tunnel and floorspace available for two interaction regions, at least o
of them with finite crossing angle, and at least one fully functional det

d) Both interaction regions allowing the same energy range and luminos

e) 80% electron polarisation

Draft distributed to ECFA/DESY

Phase 1 continued

f) Possibility to get to higher energies (some 750 GeV cms) without i
cooling and RF power, i.e. WITH REDUCED LUMI (appr. 10^34) a
gradient

Justification: explore new energy range before investing into
Question: What to state here (in particular which energy) ....

g) dp/p = +- 0.1% for e+ +- 0.3% for e-

h) Capability to run e-e- experiments

Draft distributed to ECFA/DESY

Phase 2

- cms-energy upgradeable to at least 800 GeV or 1 TeV, both of whic compatible with TESLA at Hamburg by appropriate choice of length site of the interaction region
  Justification: ttH, strong symmetry breaking, higher SUSY mass
  Question: What to state here? What's magic about 1TeV?

b) Integrated luminosity at least 500 fb-1/year at the high energy
  Question: Do we need this statement?

c) Positron polarisation of some 60%

d) High luminosity 'low energy' running (GigaZ) with at least 50 fb-1/yr v e+ and e- polarisation

e) gamma-gamma, e-gamma laser facility with lumi(gg) = lumi(e+e-)/2

f) Possibility of eN and ep collisions ???

g) ANYTHING ELSE??

…and TESLA phase-2 energy is of continuing concern… We might not know about 35 MV/m until end of 2005!

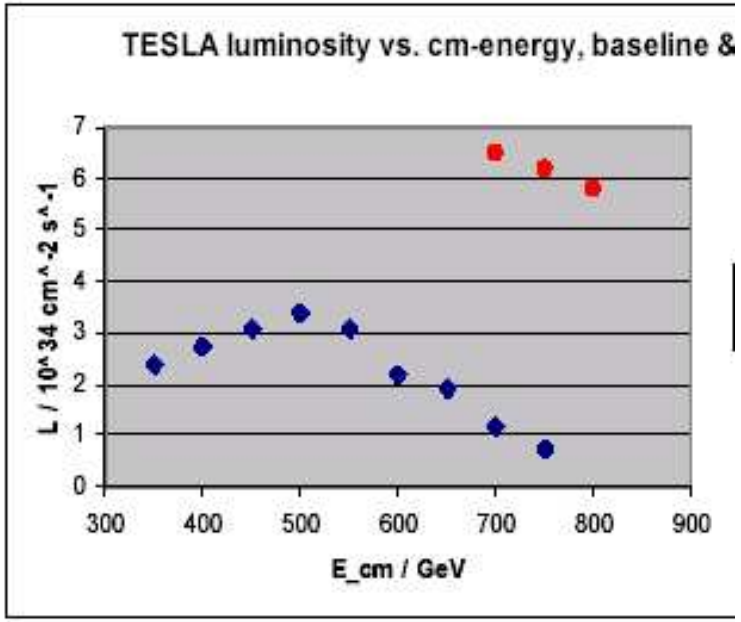
TESLA Energy Stra

TDR (March 2001)

Base line design for 500 GeV, upgrade possibility outlined

- initially operate at an energy of about 500 GeV, to explore the Higgs and related phenomena, and then
- increasing the energy to 800-1,000 GeV, to more fully explore the TeV energy scale.

Assuming that cavities will rea 35 MV/m:



Albrecht Wagner, DESY

How ILCSC has decided to choose the technology

Technology Recommer

Aim at joint selection of one technology in 1 year.

How:

- Gather a committee of wise persons, who use criteria to developed by the ILCSC, to recommend a technology choic ILCSC.
- The regional steering committees will each nominate 4 p from which the ILCSC will choose three from each list for of 9 wise persons.

First discussion of the make-up of the committee in Augus

Advice in this will be widely sought from the community.

Albrecht Wagner, DESY

Interlaboratory Collaboration for R&D Towards TeV-scale Electron-Positron Linear Colliders

International Linear Collider Technical Review Committee

ILC-TRC

International Linear Collider Technical Review Committee

Nick Walker (DESY)

Nick Walker

ECFA-DESY • NIKEF • Amste

The Rankings for R&D

- Ranking 1 — R&D needed for feasibil
  demonstration of the ma
- Ranking 2
- Ranking 3 — what you must do before y
  honestly say the machine w
  work (proof of principle)
- Ranking 4

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Rankings Score Sheet

	TESLA		JLC-C	JLC-X/NLC		CLIC	
E_{cm}	500	800	500	500	1000	500	3000
R1	0	1	2	2	0	5	2
R2	7	4	2	3	0	6	2
R3	10	3	3	11	0	5	0
R4	1	0	1	2	2	0	0

Nick Walker

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The Specific R1 Items

- TESLA
- JLC-C
- NLC/JLC-X
- CLIC

- E_{cm} = 800 GeV
  Building and testing of a cryomodule at 35 MV/m and measurements of dark curren
- Requires the module test star
- Delayed by budget constrain
- Very unlikely to happen befo 2005!

However, the push to E_z>35 MV/m continu

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The Positive Side

Rankings reflect the concerns of the working groups

But TRC overall findings were extremely positive

The ILC-TRC

"did not find any insurmountable obstacle building TESLA, JLC-C, JLC-X/NLC within the n few years…"

executive su

Nick Walker

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Brian Foster

Bristol University/DESY

Where do we go from here?

EC

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4th

- Where we are.
- What are the prospects?
- The next steps

The situation with the funding authorities

- The lead-up to the German government decision as by A. Wagner on Tuesday showed that at least in so governments, the LC is rising to the top of the agen have certainly been detailed discussions within and the UK and German governments at ministerial lev
- There are also reported to have been informal discu of LC issues at G8 science ministers' meeting.
- There is a clear need to broaden these discussions b within Europe and internationally.

Brian Foster - ECFA LC Study Amsterdam

The situation with the funding authorities

- I. Halliday, CE of PPARC in UK, was approached b
  R. Orbach (DoE) and the NSF, with the question "W
  speaks for Europe on LC issues." In an attempt to a
  this, he proposed a meeting of the funding authoritie
  subset of the European countries. This was originall
  scheduled to be held in London on 10th March, but v
  to DESY since J. Marburger, the President's Scienc
  would be at DESY that day.
- Representatives from UK, Germany, Italy, France a
  turned up and expressed a very wide range of opini
  revealed a very wide range of possible resources ava
  the various countries. There was also a wide diverge
  views on the role of CERN.

Brian Foster - ECFA LC Study Amsterdam

The situation with the funding authorities

- After the "Halliday" meeting, the participants met
  President's science advisor for a wide-ranging discu
- The hope is that the 2005 US budget will contain fu
  for a LC, together with a roadmap for US involvem
  such an international project. Dr Marburger was cl
  the LC was an important one and one in which the
  to play an important role.
- He strongly welcomed the "Halliday" group and en
  a meeting in the next 2-3 months between the Europ
  and US representatives of the funding authorities.
- 2005 is too early for a US decision on LC constructi
  2007 is "not unrealistic".

Brian Foster - ECFA LC Study Amsterdam

CERN involvement in L

- There was a substantive discussion on CERN's role i
  at both Scientific Policy Committee and Committee
  10 days ago. The CERN management had produced
  good document outlining the issues. A wide diversity
  was expressed, ranging over the same width as I disc
  wrt the Halliday committee. Everyone agreed that C
  must play an important role.
- The problem is of course that the success of the LH
  to us all and nothing must be allowed to interrupt C
  concentration on that. Also, all of CERN's resources
  devoted to the LHC until 2010, so that any CERN r
  a LC must either come after then or would require
  resources.

Brian Foster - ECFA LC Study Amsterdam

CERN involvement in L

- **The document before CC proposed:**

  CERN Council, given its mission, composition and a
  should play a major role in the definition of the Euro
  participation in a LC;
  Given appropriate resources, CERN is ~~prepared~~ to pa
  in any of the present LC projects;
  CERN urges Council to ensure that the participation
  open the option of a next step in the High Energy fro
  namely a MultiTeV LC (CLIC) to be constructed at C
  LHC

- **There was a complicated discussion, knowledge of t**
  outcome of which will have to await the appearance
  minutes. It was agreed that nothing must hinder co
  of the LHC or the possibility of its upgrade. The ab
  wording was somewhat modified. It was agreed tha
  Council President would attend "Halliday group" m

Brian Foster - ECFA LC Study Amsterdam

For US: come to Cornell July 13-16!!!

ECFA
Linear Collider Workshop

News from Organising Committee

Future workshops

November 2003 (2 possible venues)
LCWS Paris, 2004 (2nd ½ of April)
Autumn 2004
Spring 2005
(more suggested venues than available dates)

"Physics in Data" Challenge. Generators group to be asked to prepare a mix sample of events containing unspecified new physics. Simulation group to app detector and beam imperfections. Analysis by Spring 2005 workshop.
(Competing teams from the Physics groups?)

Group and collaboration **meetings between workshops strongly encourage** including unofficial meetings on day before workshop.

Opening plenary session of workshops will include **Overviews of progress in R&D fields.**

More MDI sessions to be scheduled to cover increasing activity on instrumentation etc., some parallel with physics, some with detectors.

Small **"Devil's Advocate" group** to report in Autumn 2003 on gaps and weaknesses of the present detector.

David Miller @ Amsterdam 4/4/03