Annecy Meeting 報告

田内利明（高エネ研）、２月１６日（１９９５）、川渡にて

９月８～１２日に開催される第３回LCWS（盛岡）に向けてのヨーロッパの一連のworkshop(LC2000)の第一回目。

第1回：2月4日、Annecy

1日目　Plenary talks on present status of WGs,結団式

第２回：６月２～３日、GranSasso

1日目　ワーキンググループによるparallel sessions

2日目　Plenary talks, e^-e^-, $e\gamma$, $\gamma\gamma$衝突のオプション、TESLAグループおよびJLCグループなどからの招待講演

第３回：８月３０日～９月１日、DESY

1日目　ワーキンググループによるparallel sessions

2日目　Plenary talks on machine(s-band,TESLA) reviews and experimentation

3日目　Plenary talks on physics

Program of Physics with e^+e^- Linear colliders

Annecy February 4, 1995

別紙参照

P.ZerwasのIntroduction: Frame of the Workshopにしたがって報告します。

LC2000の目的

第 1 , 2 回のLCWSはphysics at 500GeV(Phase-I)。
今回(第 3 回)はphysics in Phase-II,e^+e^-colliderで到達しうる最高重心系エネルギーの 2 TeVでの物理。

"2'nd phase must be defined when 1'st phase is proposed." <- extendability in the same tunnel

European Linear Collider = TESLA

for TESLA parameters

Ecm	500GeV	1TeV	2TeV
MV/m	25.	25.	40.*
σ_x/σ_y (nm)	1000./64.	325./8.	325./8.
L($10^{33}cm^{-2}sec^{-1}$)	2.6	5.3	65.
L(fb^{-1}/year)	26.	53.	650.
$\delta E_{loss}/E_b$ (%)	2.6	5.3	11.

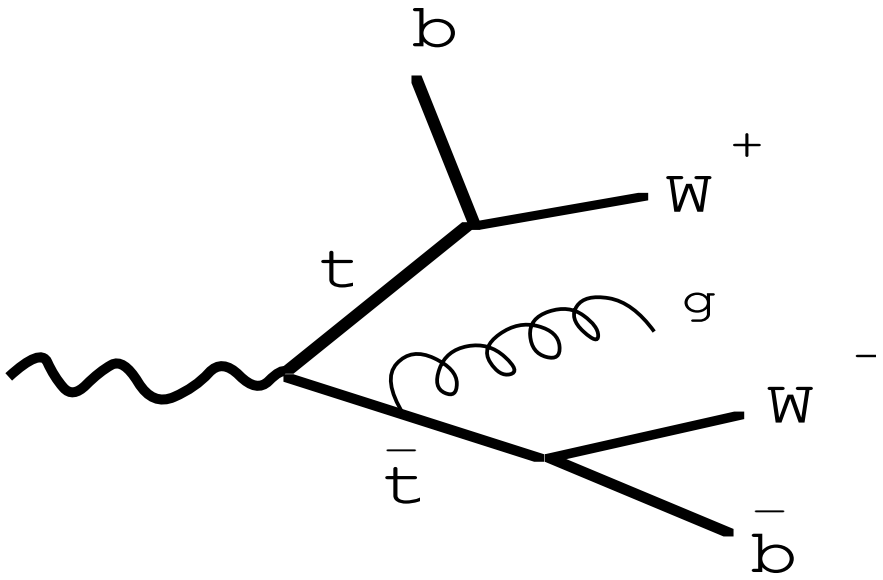
*:theoretical Maximum = 60MV/m

with options of e^+e^- as Z factory, e^-e^-, $\gamma\gamma$, $e\gamma$

internally reviewed after technical proposal submitted by 1997.

Physics at 2TeV

1. Top (J.H.Kuehn)



Top quark can move 1/2fm before it decays because of γ_t=5

- gluon radiation from top (perturbative QCD)?
- fragmentation function?

Exotic anomalous hard couplings proportional to s/m_t^2?

Yukawa coupling in

e^+e^- -> $t\bar{t}Z$ σ = 1 ~ 5 fb

e^+e^- -> $t\bar{t}H$ σ = O(1) fb

Boson fusion production in

e^+e^- -> $\nu\bar{\nu}$ $t\bar{t}$ σ = O(1) fb

e^+e^- -> $\bar{\nu}$ e^- $t\bar{b}$ σ = O(1) fb

2. QCD (S.Bethke)

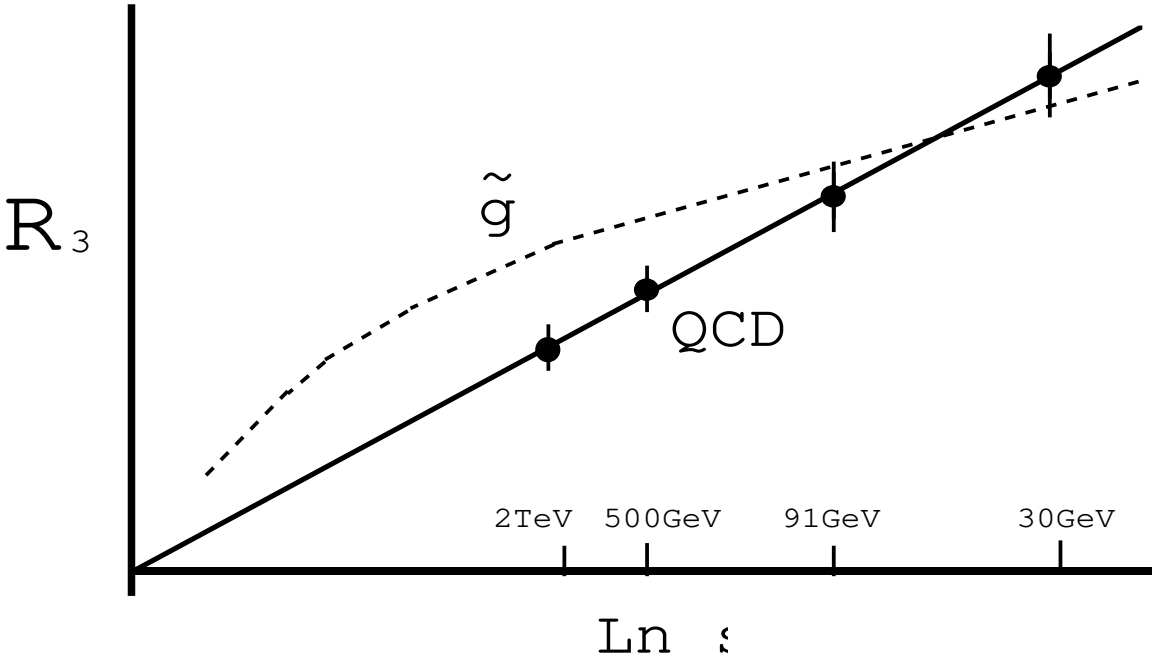
Hadronic background for new physics

α_s determination

Much reduced hadronization effects for clear test of QCD

Backgrounds of $t\bar{t}$, WW can be discriminated by 2-dimensional correlation plot of M_1 vs M_2 which are invariant masses of 2-hemispheres.

$R_3 = \sigma_{3\text{-jet}}/\sigma_{2\text{-jet}} \sim \alpha_s(s) \sim 1/\ln s$



$\Delta\alpha_s/\alpha_s$(theoretical error) = +/- 5% at LEP-I

+/- 4% at 500GeV

+/- 3% at 2 TeV,

where statistical error is 1%.

LC-operation with $10^{33}cm^{-2}s^{-1}$ for 30GeV<Ecm<500GeV.

3. Higgs (P.Janot/P.Zerwas)

No study has been done since LCWS93 (Hawaii). (Janot).

SM: up to 1TeV

SUSY: low energy h
high energy H, A, $H^{+(-)}$... up to 1TeV for all
tanβ which LHC is difficult to see.
--> MSSM, (M+1)SSM

4. New physics signals in the SM bosons (G.Gounaris)

light higgs : old physics

heavy higgs : new physics

New physics(NP)may be hiddenin anomalous interactionsamongW, Z, γ, H, (t,b).

If Λ_{NP} >> v, NP should be dominated by dimensional 6 operators.

e^+e^- -> W^+W^- : $O_{B\phi}$, $O_{W\phi}$, Q_W

NLC is γ andW collider!

$\gamma\gamma$, eγ colliders can study all 6-dim. operators, especially for $O_{\nu W}$, $O_{\nu B}$ and $\overline{Q_{\nu W}}$, $\overline{O_{\nu B}}$ which are anomalous only for Higgs interactions and the latter mimic O^- Higgs.

eγ -> WZ, Wγ

$\gamma\gamma$ -> H for $\overline{O_{\nu W}}$ ($H F_{\mu\nu}\overline{F^{\mu\nu}}$)

Heavy Higgs option

$\Lambda_{NP} = 4\pi v = 3$TeV

SM gauge boson interactions

anomalous dipole/quadrupole moments; dσ ~ s

e^+e^- -> $\overline{w}$ W^+W^- ; W^+W^- -> W^+W^- : a_{IJ}

e^+e^- -> W^+W^- ; rescattering : a_{11}

5. Non-standard Gauge Theories

(C.Vezegnassi)

There are 3 options.

(a) h and SUSY are found. pessimistic.

(b) no h. optimistic.

(c) nothing is found. very optimistic.

(b) Z'

e^+e^- -> $f\bar{f}$ (σ_μ, A_{FB}^{μ}, $R_h=\sigma_h/\sigma_\mu$ and A_{LR}^{h}, A_{LR}^{μ})

Mz' > 8 ~ 16TeV with 320fb^{-1} at 2TeV.

6. SUSY(A.Bartl)

Pair production of LVSP(Lightest Visible Super Particle);

χ_2^o, e_R, μ_R, τ_1, b_1(if tanβ>10?), t_1

$\sigma \cdot B > 10$ fb

Signature:largemissingPt

Difficulty: smallvisible energy

and cascadedecay;

e^+e^- -> $\chi_2^o\chi_2^o$-> $h^o h^o$ + missingenergy

$e\gamma$ -> $e\chi^o$ -> e + missingenergy

CP violation in NMSSM;

e^+e^- -> $\chi^+\chi^-$ A_T = 5%(unpol.) -> 10%(pol.)

MC generator:SUSYGEN like as PYTHIA

Introduction of a nice work by T.Tsukamoto et.al.

e^+e^- -> $e_R^+e_R^-$ and e^+e^- -> $\chi^+\chi^-$

from a global fit to m_{χ^+} , $m_{\chi o}$, $\sigma_R(e_R^+e_R^-)$,$\sigma_R(\chi^+\chi^-)$

M_1, M_2, μ and tanβ can be determined.

7. $\gamma\gamma$ Physics(P.Aurenche and I.Ginzburg)

F_2^γ and jets (QCD minijets)

F_2^γ;

$<Q^2>=6GeV^2$	$15GeV^2$	Ecm
xmin = $3 \cdot 10^{-3}$	$7 \cdot 10^{-3}$	500GeV
xmin = $7 \cdot 10^{-4}$	$1.7 \cdot 10^{-3}$	2TeV

note: Mask aperture sets Q^2_{min}.

Jets measurements as a function of rapidity(η)

<--- H1 sees a discrepancy compared to theoretical models.

Diffractive vector ($\rho,\omega,J/\psi$) and pseudo-scalar(π) meson productions by pomeron(2-gluon) and oderon(3-gluon) exchanges, respectively.

$\sigma_{\gamma\gamma}$ is closely related with HERA,Tevatron and LHC via;

$$\sigma_{\gamma\gamma} = (\sigma_{\gamma p})^2/\sigma_{pp}$$

PLC: $\gamma\gamma$ collider <- VLEPP

80 < Ecm < 200 GeV

7. e^-e^- collider (C.Heusch)

Heavy Majorana Neutrino

in $e^-e^- \rightarrow W^-W^- \rightarrow \mu^-\mu^-, \mu^-\tau^-, \mu^-e^-$ + missing energy

8. Experimentation (R.Settles)

Plan machine phases and build detector adapted

ILC-TRC : coherent overview of present status of R/D
first step to CDR (Conceptual Design Report)

Phase-I: 500GeV

(a) Ecm=250GeV with L=0.5 fb^{-1}

M_h<150GeV for a definitive test of SUSY,
WW coupling is 1.5 ~ 2. times better than LEP200.

(b) Ecm=350GeV for toponium

(c) Ecm=500GeV

Phase-II: 1 ~ 2 TeV

Ecm, Luminosity ?

for 800GeV Higgs
W^+W^- interactions (1.5TeV, 200fb^{-1} by T.Barklow)

Alternative operation while a machine is upgrading from phase-I to -II;

Z^o factory
$\gamma\gamma$, $e\gamma$ and e^-e^- colliders

European detector, linear collider(TESLA) with $\gamma\gamma$,$e\gamma$ options.
Ready for ZDR (0th design report as JLC-I) by 1996, and
CDR by 1997 ~ 8.

Parameters for physics consideration

Ecm	500 GeV	1 TeV	2 TeV
$L(fb^{-1})$	20.	80.	320.
$\delta E_{loss}/E_b$ (%)	2.	2.	10.

DESY訪問

1. TESLA test facility

50m long LINAC with 32 cavities(9 cells), 15MeV/m at 2K, which will be completed by summer 1997.

Upgrade Plan;

acc.(MeV/m): 15. -> 25.(TESLA std) - adding more-->

energy(MeV): 500. -> 800. --> 1000. ~ 2000.

machine : LINAC FEL (Xray source)

Total cost < 50$10^6$ マルク

Facility:

(a) Clean room (10,000 -> 100 KL)

(b) Chemical room for etching surface of SC-cavities

(c) 1400°C oven (heat treatment)

(d) Vertical(Sacley) and horizontal(Orsay) test dewar with high power

(e) High pressure rinsing

40MeV/m ?

It may be practically impossible because of a large area of 9 c structure while a single cell can be achievable.

TESLA can be operated with a parasitic FEL(A source) which uses a whole TESLA-LINAC.(J.Rossbach)

2. S-band test facility

500MeV LINAC with two 150MW klystrons which will be shipped to DESY from SLAC in this February, 17MeV/m with no pulse compression.

Beam: 16nsec x 125 bunches / 2 μsec, 1.0×10^{10}/bunch

Test of multi-bunch and high current acceleration by measurir beam energy and bunch length etc. .

The s-band test facility will be completed in next year(1996).
After the test, it will be a spare for electron-LINAC of HERA.