



Progress Report

1. Prehistory
2. Extended Study; Krakow, St. Malo
(Prague, Amsterdam)
3. The Future

<http://www.desy.de/conferences/ecfa-desy-lcext.html>



Prehistory

European studies have driven the programme for the linear collider, starting in 1991; producing DESY 123 A, B, C, D

1st ECFA/DESY Study from 1996, on

"Physics and Detectors for a Linear Collider"

produced DESY 123E and large parts of
TESLA Conceptual Design Report (1997)

2nd ECFA/DESY Study from 1998; culminating in the

TESLA TDR(2001) and the colloquium

(+ refereed LC notes on the web)

Strong favourable recommendations from Foa ECFA panel
+ HEPAP sub-panel depended on our input through the
TDR and at Snowmass.



Extended Study
approved by ECFA to
Spring 2003

Goals:

to continue to **build up the active community of experimenters, theorists and machine physicists who prepared the TESLA Technical design Report**

to be ready by 2003 to make firm proposals for a funded programme of linear e+e- physics up to about 1 TeV.

to **complete and extend feasibility studies on important physics channels.**

to **review the detector design in the light of results of the R&D programmes** now starting

to **interact with the accelerator designers** on questions relating to the machine/detector interface, including backgrounds, shielding, radiation levels, beam position monitoring, luminosity measurement and energy measurement.

to look at the physics potential and the technical possibilities for **extensions of the programme to produce real photon-photon, electron-photon and e-e- collisions.**

to extend the work of the "**LoopVerein**", developing new tools and techniques for calculating precise rates for Standard Model and supersymmetric processes to match expected experimental precision.

to continue and **extend contacts with physicists in North America, Asia and throughout the world.**



Workshops

Krakow 14-18 September 2001 - good start, inhibited by September 11

St Malo 12-15 April 2002

~180 participants: 18 from North America (including co-chairs of US Study); 1 from Japan.

Well established Physics working groups on:

- | | |
|---------------------------------|-------------------|
| HIGGS + SUSY Higgs; | SUSY Particles |
| Electroweak and Alternatives | QCD and top quark |
| $\gamma\gamma, e\gamma$ Physics | LoopVerein |
| Generators | |

Detector and Machine/Detector sessions on:

- | | |
|----------------------------|--------------------------------------|
| Vertexing | Tracking |
| Calorimetry | $\gamma\gamma, e\gamma$ technologies |
| Machine/Detector interface | Simulation |

Readout and DAQ

continued...



St Malo

New sessions:

Energy-flow measurement

Applications of positron polarisation

LHC/LC complementarity (getting a joint group going)

Special plenary talks

"Scenarios for SUSY breaking" H.P.Nilles

"Report from the Loew panel" Nan Phinney

A tiny selection of slides from some of the sessions:

Top mass and top Yukawa coupling to higgs

LoopVerein

Polarisation

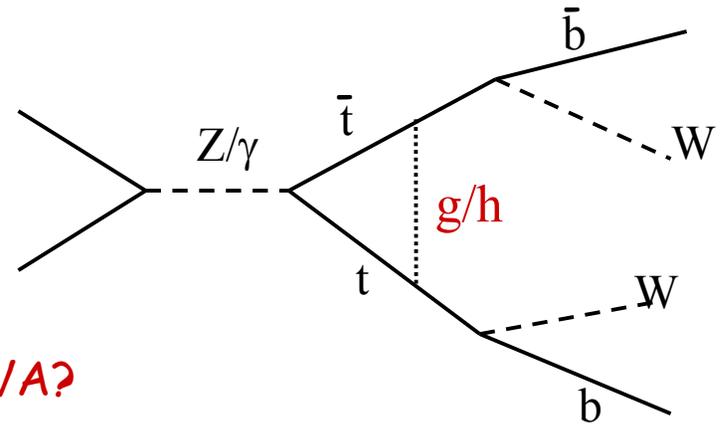
$\gamma\gamma$, $e\gamma$ technologies

Tracking

Calorimetry

Short t lifetime means perturbative.
Special QCD schemes developed for
mass at threshold.
Gluon dominates final-state corrections,
but α -s is well measured

SO IS THERE SENSITIVITY TO YUKAWA?



- New Multiparameter Fits to the $t\bar{t}$ Threshold observables allowing to estimate the accuracy on Top Yukawa presented at Krakow (M.Martinez and R.Miquel). No theoretical uncertainties taken into account.
- A new calculation of the $t\bar{t}$ cross section at NNLL order and an estimate of the theoretical uncertainties also presented at Krakow (A.H.Hoang, A.V.Manohar, I.W.Steward and T.Teubner).

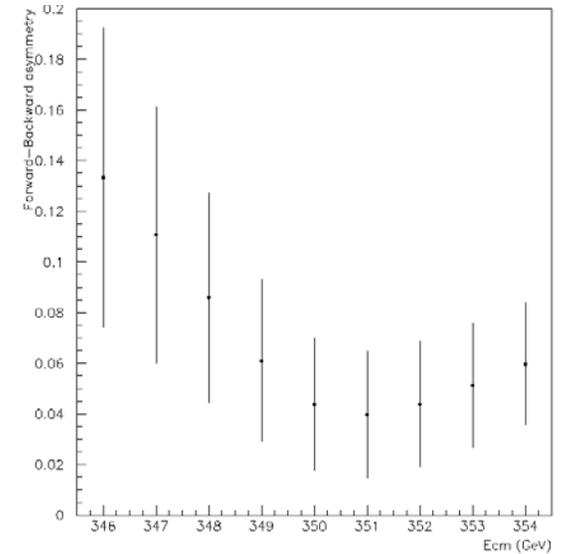
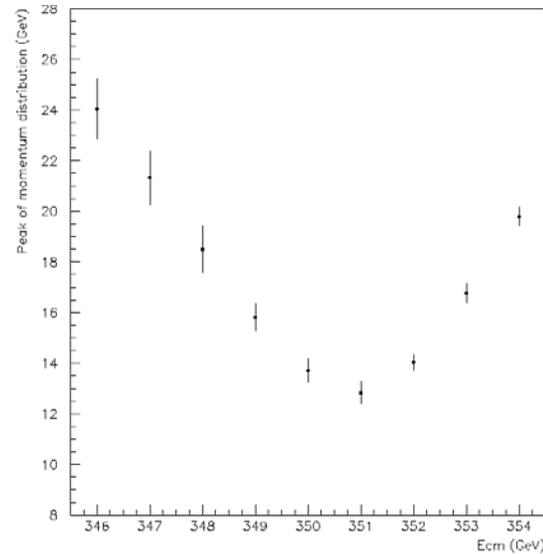
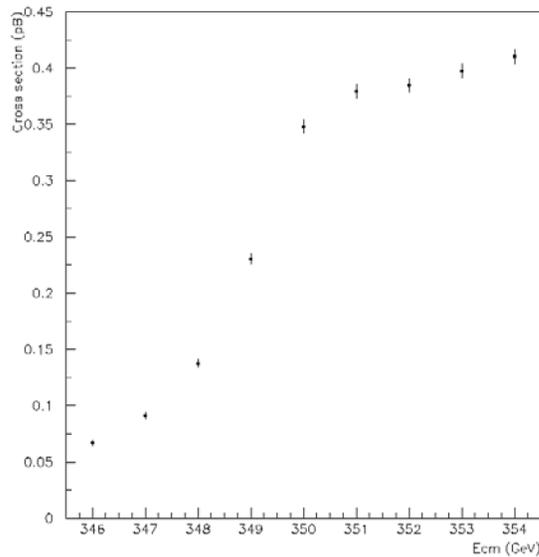
=> TRY to put both together



Martinez and Miquel
fitting m -top, α -s, top-width
and Yukawa coupling

The Simulation Conditions

(assuming TDR detector performance AND good measurement of Lumi. spectrum)



Cross section

Peak of momentum
distribution

FB asymmetry

Multiparameter fit strategy

- So far, only single-parameter (or at most double-parameter) fit tried to the threshold scan observables to study potential for the determination of the top width and top Yukawa coupling potential.

BUT

- Sensitivity to top width mainly dominated by **cross section** (only small improvement by adding FB asymmetry and top momentum distribution)
- Sensitivity to top Yukawa coupling also dominated by **cross section**.

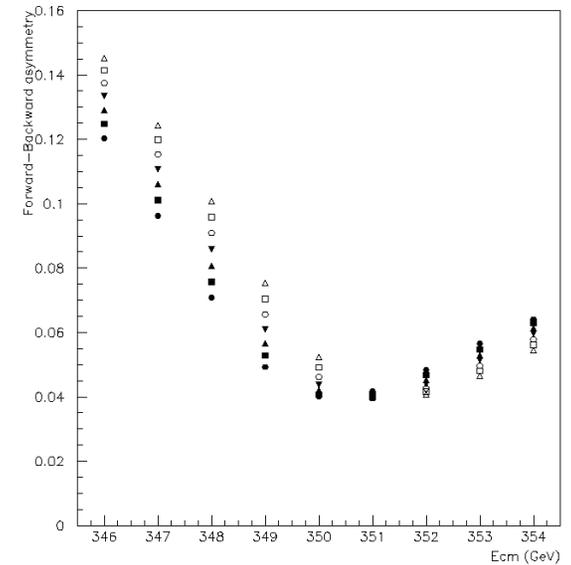
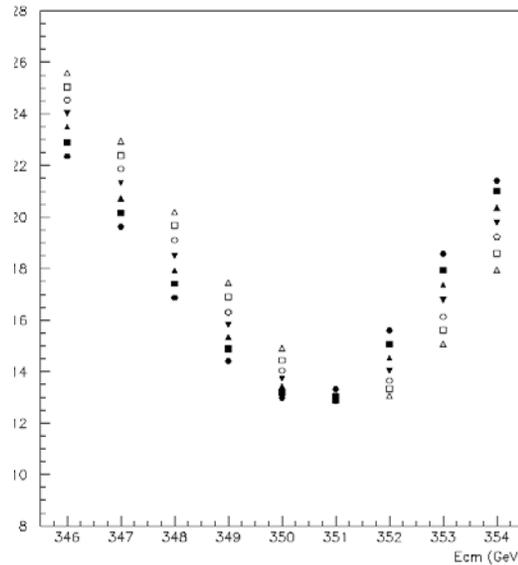
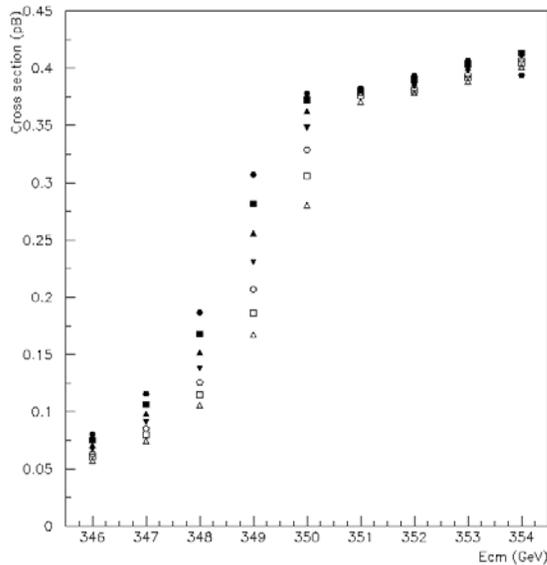
=>



Martinez and Miquel
fitting m_t , α_s , top-width
and Yukawa coupling

Fit to m_t and α_s

$\Delta m_t = 100 \text{ MeV}$



Cross section

Peak of momentum
distribution

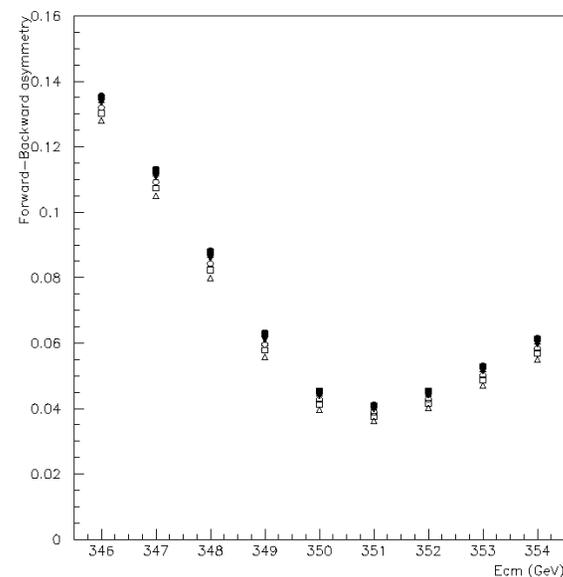
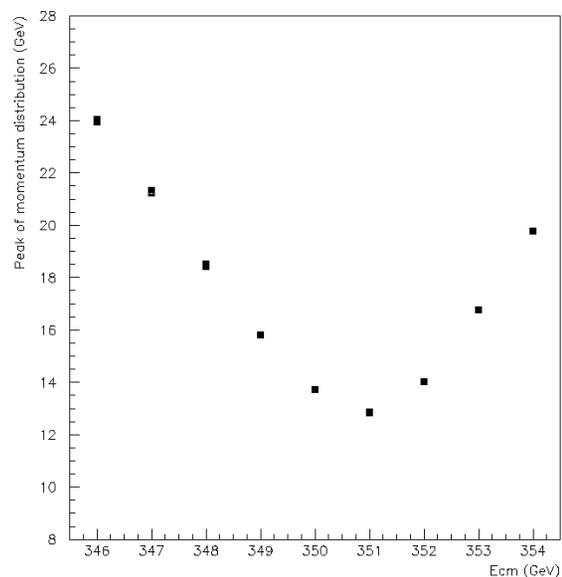
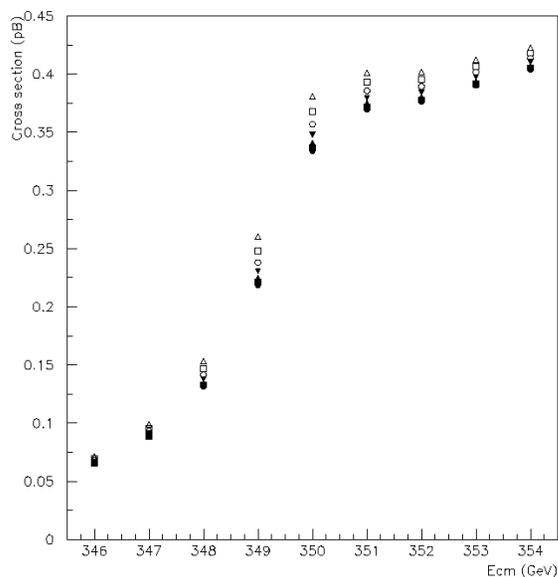
FB asymmetry



Martinez and Miquel
fitting m-top, alpha-s, top-width
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Fit to top mass and The Yukawa Coupling

$$\Delta\lambda_t/\lambda_t = 0.25$$



Cross section

Peak of momentum
distribution

FB asymmetry



Martinez and Miquel
fitting m-top, alpha-s, top-width
and Yukawa coupling

The Yukawa Coupling (4 parameter)

- We do not know yet the actual Theoretical Uncertainty in the threshold cross section shape with the new calculation: compare 1% global with 1% point to point uncertainty on each scanning point.

$\Delta m_t = 31 \text{ MeV}$	$\Delta \alpha_s = 0.001$ (constraint)	(1% global Th. Uncert.)
$\Delta \Gamma_t = 34 \text{ MeV}$	$\Delta \lambda_t / \lambda_t = +0.34 -0.65$	(correlations up to 0.85)
$\Delta m_t = 36 \text{ MeV}$	$\Delta \alpha_s = 0.001$ (constraint)	(1% point to point Th. Uncert.)
$\Delta \Gamma_t = 60 \text{ MeV}$	$\Delta \lambda_t / \lambda_t = +0.36 -0.72$	(correlations up to 0.85)



Martinez and Miquel
fitting m -top, α_s , top-width
and Yukawa coupling

Conclusions

- For the first time new estimate of theoretical uncertainties included in a multiparameter fit of the threshold observables.
- A realistic parameter uncertainty estimate requires an estimation of the theoretical uncertainty of the threshold cross section shape predictions => waiting for code from Teubner et al.
- Theoretical uncertainties in the top momentum distribution predictions might also play a relevant role => progress expected ?
- The new theoretical normalization uncertainty is small enough not spoil the expected experimental errors and should allow a meaningful simultaneous fit of the strong coupling constant $\Delta\alpha_s = O(0.001)$ (provided the top Yukawa is assumed to be perfectly known).
- Measuring the top Yukawa coupling with a top threshold scan looks difficult:
 - Experimental error around 30%
 - Much more difficult for Higgs masses above 120 GeV

{A further conclusion (DJM); theories with large top Yukawa couplings can be ruled out!}



The Future

Concrete plans

LCWS 2002, Jeju Island, Korea, 26-30 August
(organised by the Worldwide LC Study of which ECFA/DESY is one leg)

Prague, 15-18 November 2002.

(+ special detector performance session. More on LHC/LC complementarity)

Amsterdam, Spring 2003

(with proceedings to "wrap up" the present Study)

Momentum must be maintained while political decisions are made

Loew panel will report summer 2002 →

Regional Steering Groups have formed; International S.G. at ICHEP.

German Government decision; maybe in 2003

OECD consultative group keeping in touch

Growing national commitments to serious R&D spending: LC and X-FEL

(Detectors too; new report from Worldwide LC Study panel)



What next?
Waiting for the green light

At St. Malo we agreed that our work must continue. ECFA support has been important and we would like to find a way to continue it. (There were good omens)

We will make suggestions to RECFA in early Autumn and hope to bring a proposal to the December ECFA meeting.