

## 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<sup>+</sup>e<sup>-</sup> 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<sup>-</sup> 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...

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

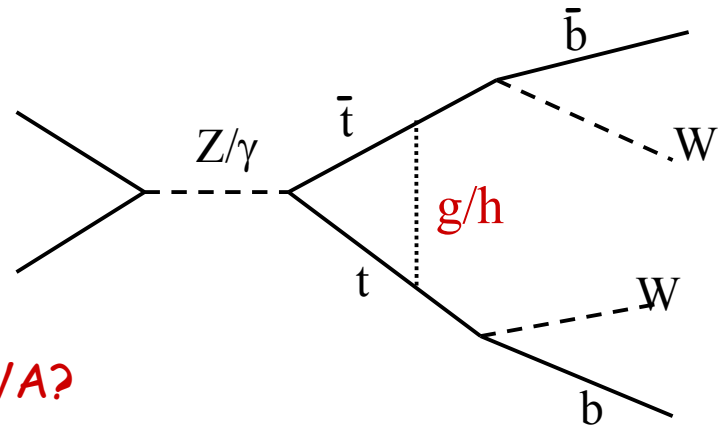
$\gamma\gamma$ ,  $e\gamma$  technologies

Tracking

Calorimetry

Short  $t$  lifetime means perturbative.  
 Special QCD schemes developed for  
 mass at threshold.  
 Gluon dominates final-state corrections,  
 but  $\alpha$ -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).

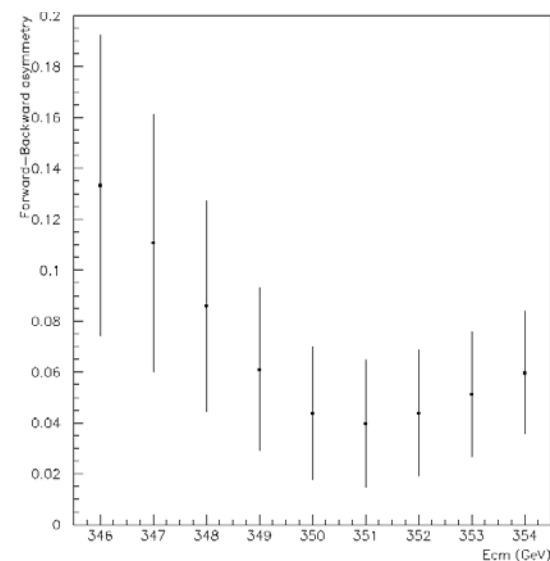
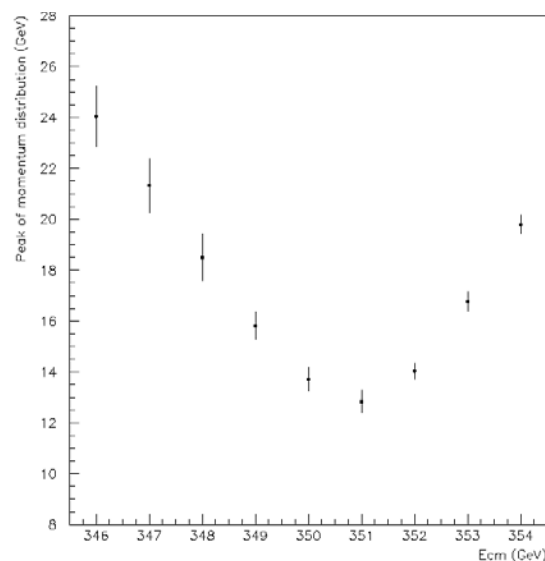
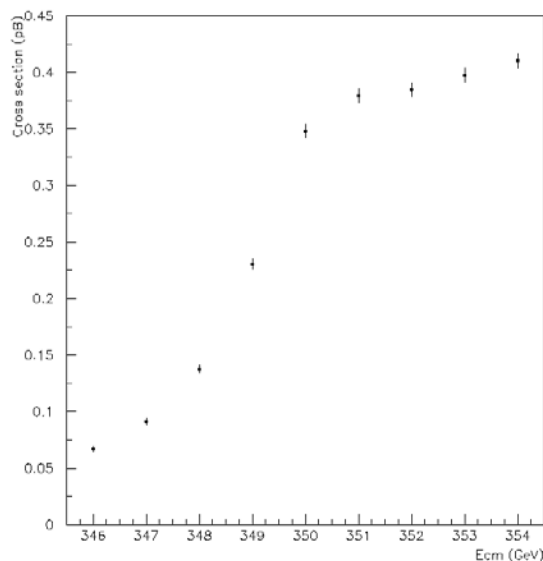
**=> TRY to put both together**



Martinez and Miquel  
fitting  $m$ -top,  $\alpha$ -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.

=>

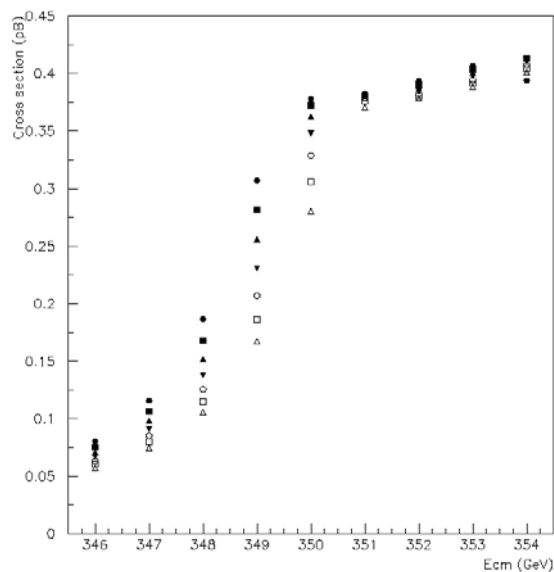




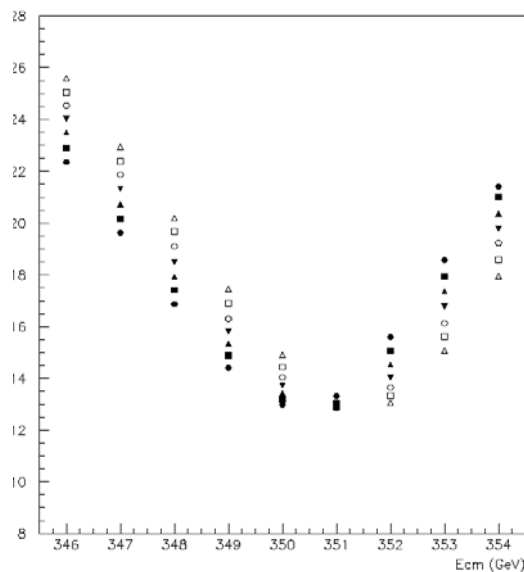
Martinez and Miquel  
fitting  $m_t$ ,  $\alpha_s$ , top-width  
and Yukawa coupling

Fit to  
 $\underline{m_t}$  and  $\underline{\alpha_s}$

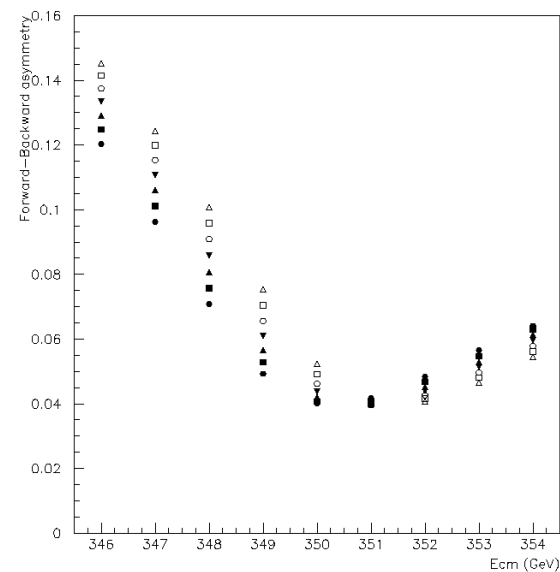
$\Delta m_t = 100 \text{ MeV}$



Cross section



Peak of momentum  
distribution



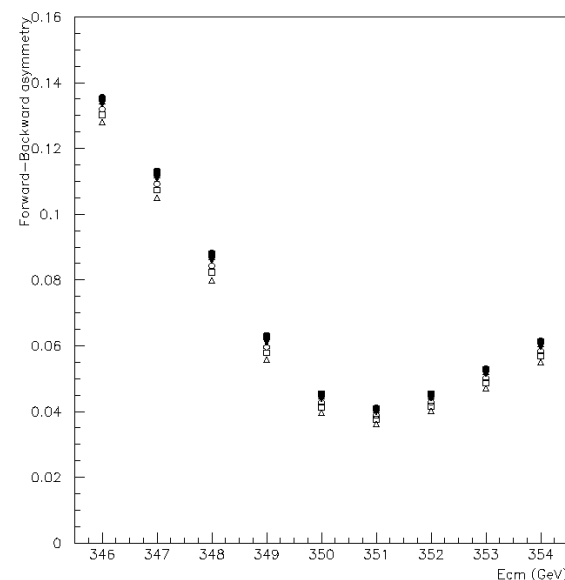
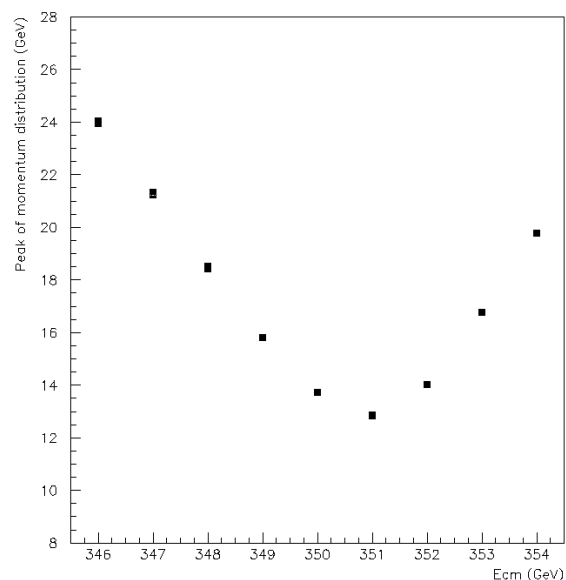
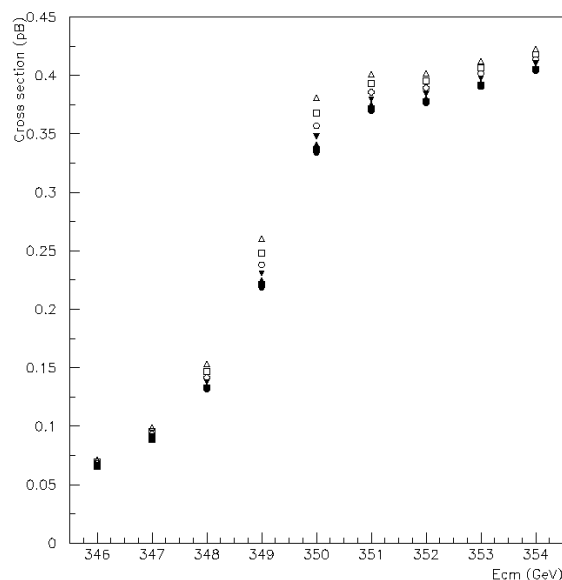
FB asymmetry



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

# Fit to top mass and The Yukawa Coupling

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



Cross section

Peak of momentum  
distribution

FB asymmetry

## 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.)

$\Delta \Gamma_t = 34 \text{ MeV}$        $\Delta \lambda_t / \lambda_t = +0.34 \text{ } -0.65$  (correlations up to 0.85)

$\Delta m_t = 36 \text{ MeV}$        $\Delta \alpha_s = 0.001$  (constraint)      (1% point to point Th. Uncert.)

$\Delta \Gamma_t = 60 \text{ MeV}$        $\Delta \lambda_t / \lambda_t = +0.36 \text{ } -0.72$  (correlations up to 0.85)

## 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  $\Rightarrow$  waiting for code from Teubner et al.
- Theoretical uncertainties in the top momentum distribution predictions might also play a relevant role  $\Rightarrow$  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  $\Delta\alpha_s = \mathcal{O}(0.001)$  (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.