

Full Simulation and Reconstruction with BRAHMS (G3) TESLA

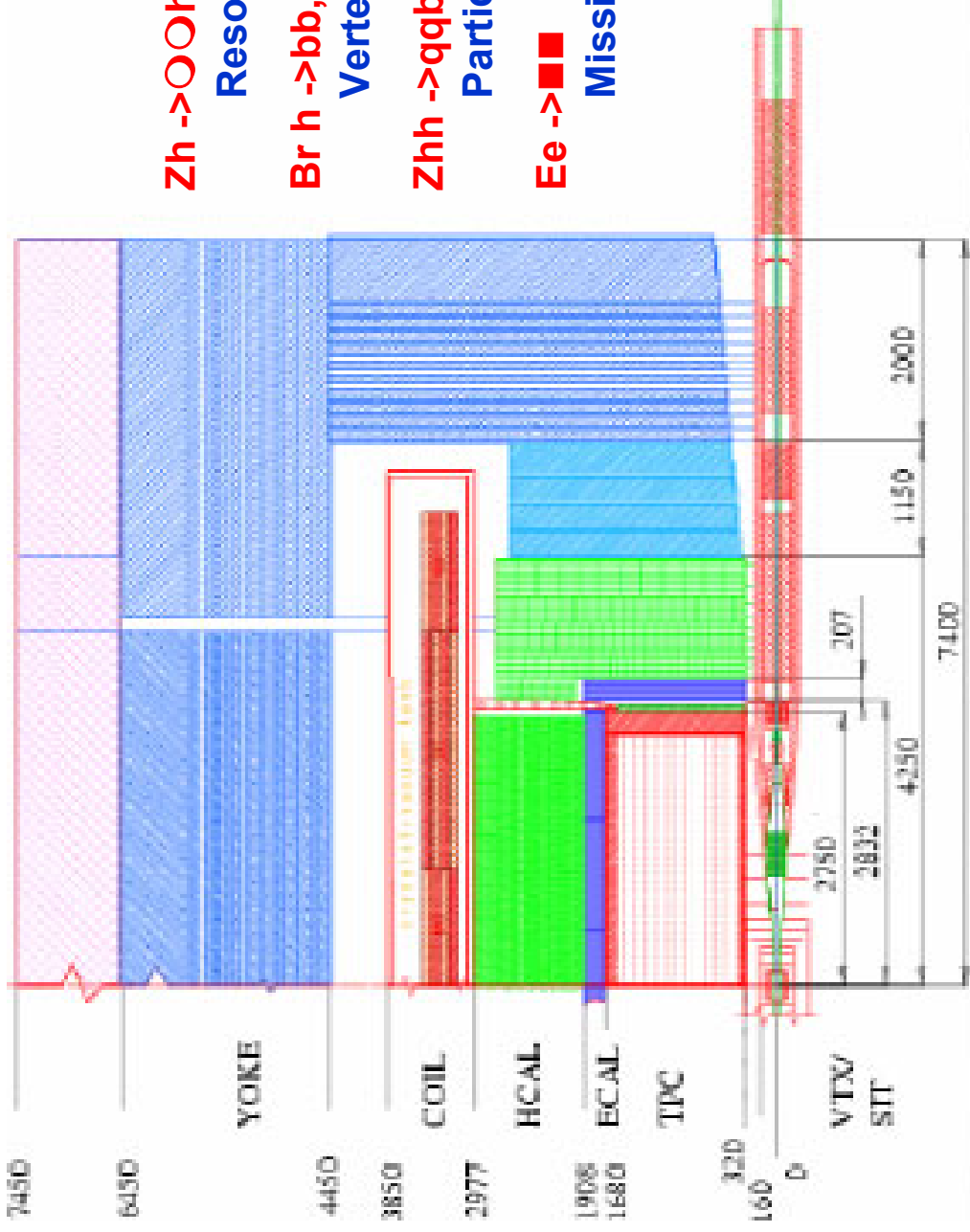
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DESY, Hamburg / Obninsk State University, Russia

20.04.2003

LCWS, Paris

TESLA LC Detector



Zh \rightarrow $\circ\circ h$ - Precise momentum Resolution

Br h \rightarrow bb, cc, gg - Exelent Vertexing/Flavor Identification

Zhh \rightarrow $qqbbbb$ - Exelent Calorimetry, Particle Flow Algorithm;

Ee \rightarrow \blacksquare h - Exelent Hermeticity, Missing Mass Resolution

TESLA LC Simulation and Reconstruction Frame

- Physics Generator and realistic **Beam Strahlung** processes on base **CIRCE**- Beam Spectra for Simulating Linear Collider Physics,
- G3 based TESLA MC simulation frame: BRAHMS v308
- Full Geometry for TESLA TDR Spectrometer is available and running well.
- Interface LCIO for Full Monte Carlo simulation provide the interface to different reconstruction frames
- Reconstruction Frame of Brahms - RERECO

Track Reconstruction – very powerful, based on the LEP experience.
LCIO interface.

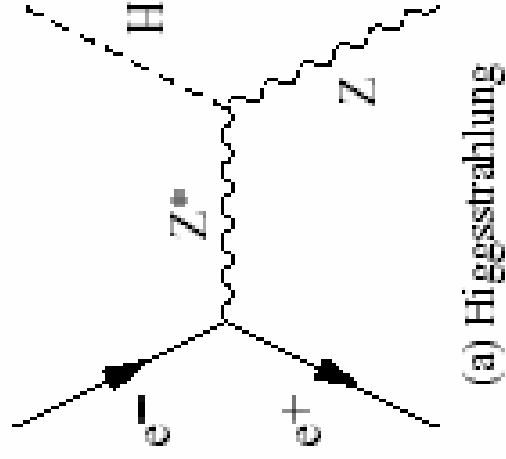
Calorimeter Reconstruction talk A.Raspereza

Benchmark process

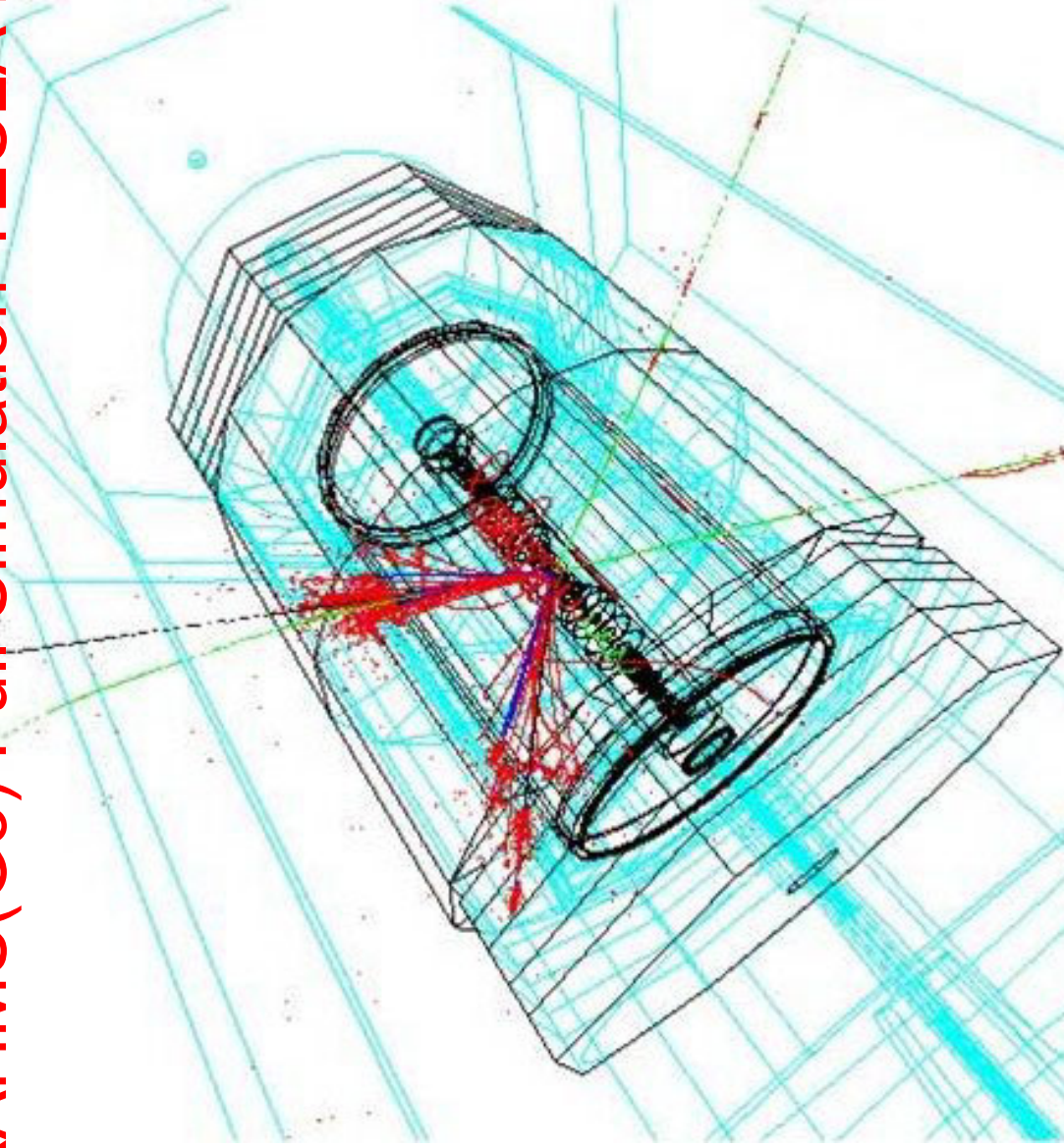
SM Higgs in Higgsstrahlung

- Pythia 6. – version (including ISR)
- CM Energy is 500 GeV, Higgs mass is 140 GeV,
 - Z^0 is forced decay to l^+, l^- ($ee, \mu\mu$),
 - h^0 is forced decay to $b, b\bar{b}$ (for further investigations),

LCIO Interface Pythia/Brahms HEPEVT format based.



BRAHMS(G3) Full Simulation TESLA LC

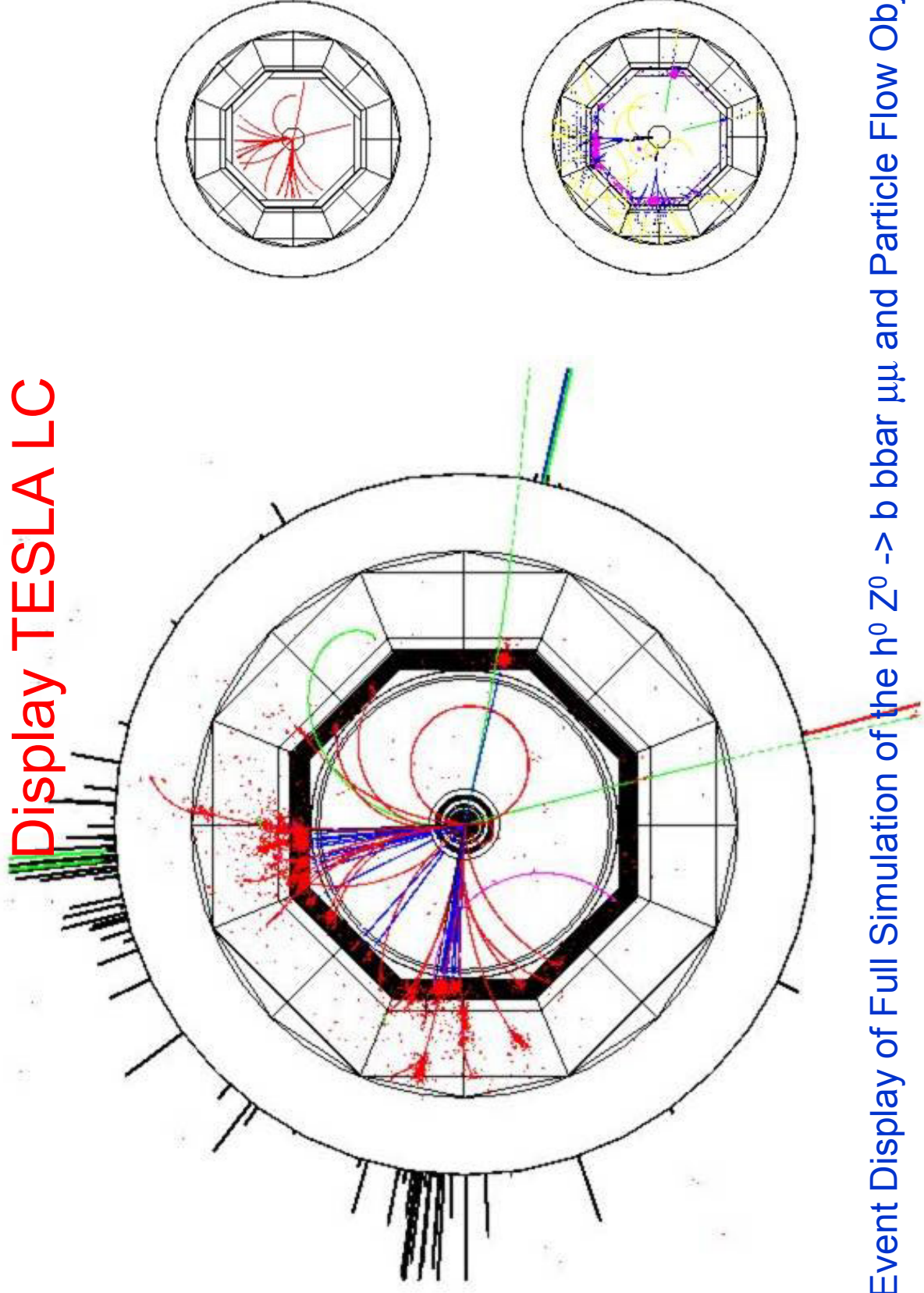


TESLA geometry and Full Simulation of the $h^0 Z^0 \rightarrow b \bar{b} \mu \mu$

April 20, 2004

V.Saveliev

BRAHMS(G3) Simulation and Reconstruction Display TESLA LC



Event Display of Full Simulation of the $h^0 Z^0 \rightarrow b \bar{b} \mu \mu$ and Particle Flow Objects

April 20, 2004

V.Saveliev

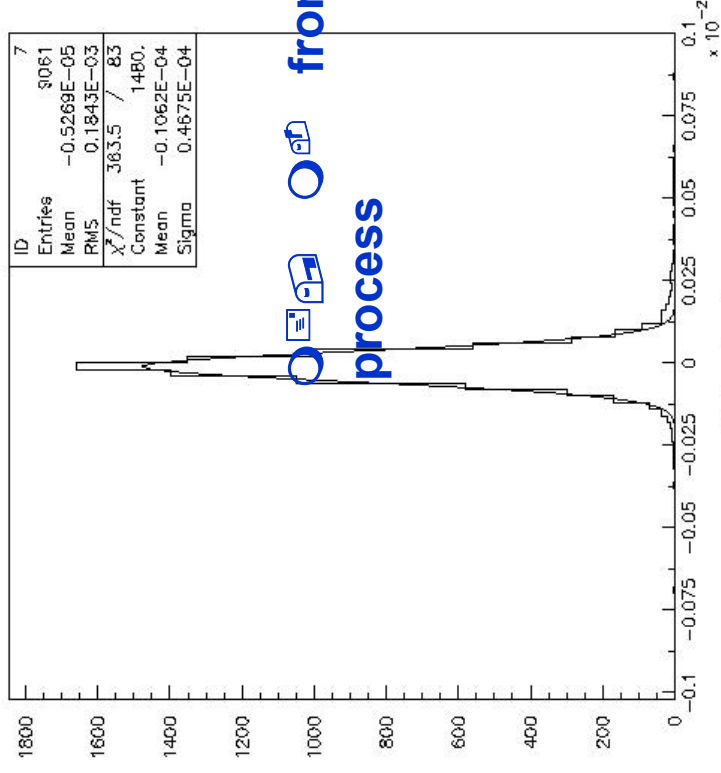
Brahms RERECO Tracking

Steve Aplin (DESY) is working on the tracking in the Brahms RERECO – based on the LEP experience

Goal : reconstruction Z line shape with natural width

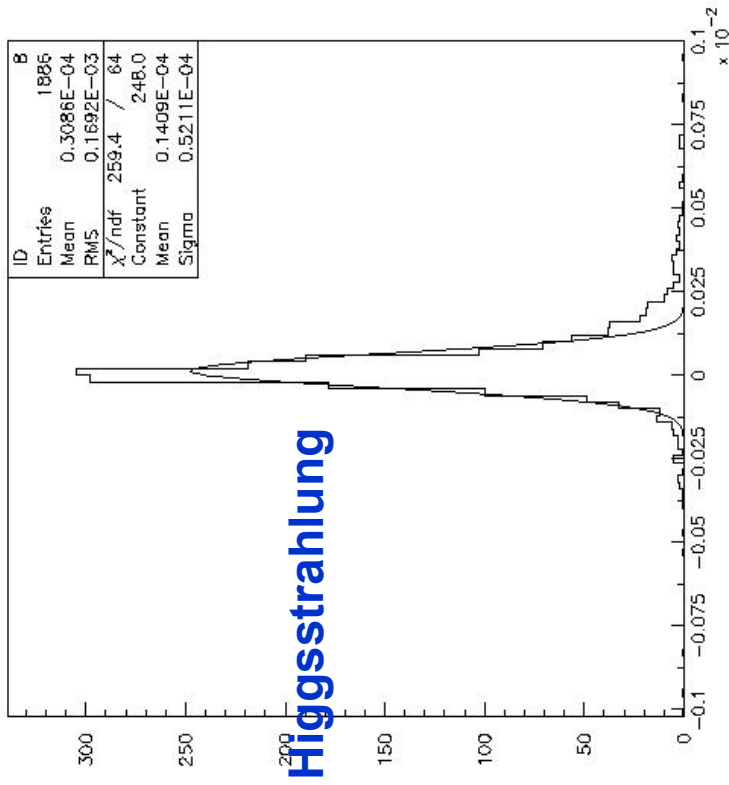
$$\sigma(1/p) = 7 \times 10^{-5}$$

$$\text{GeV}^{-1}; \quad \sigma = 0.27 \text{ GeV} \ll \sigma_{\text{th}}$$



process

from Higgsstrahlung



Forward region 5.5×10^{-5}

Central region 4.7×10^{-5}

Method of Analysis

The Invariant Mass of Invisible System (the Recoil Mass Method):

The recoil mass is determined by requiring energy and momentum conservation and by constraining the invariant mass of the visible system to the Z mass.

$$m^2_X = s - 2\sqrt{s}(E_{l^+} + E_{l^-}) + m_Z^2$$

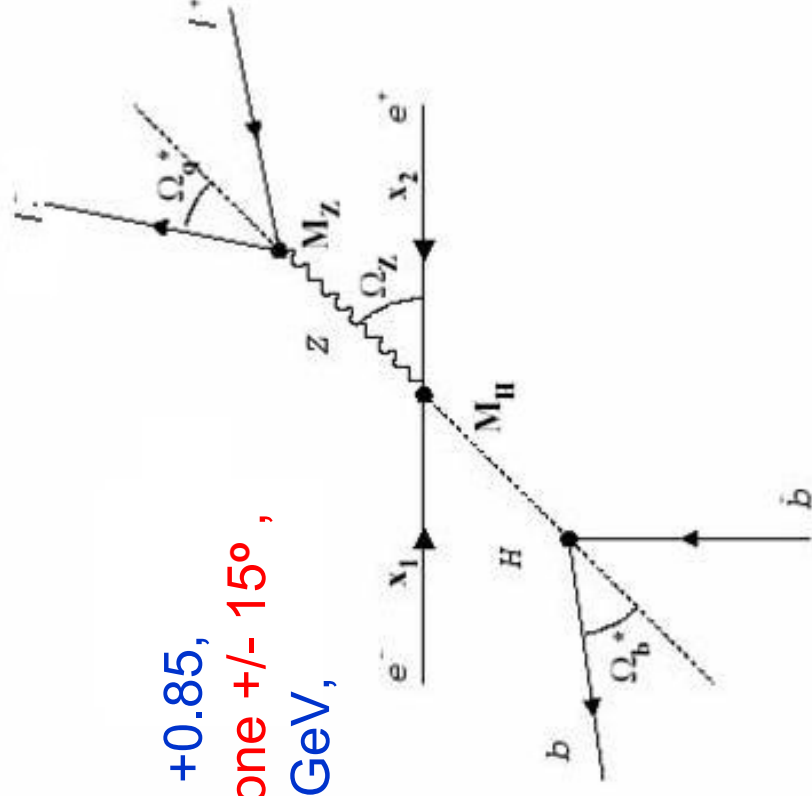
In the topology first identify two leptons with invariant mass close to mass of Z0, and then investigate the remaining hadronic mass or use the kinematic constraints to study the missing mass in the event.

This method is independent of assumption about SM Higgs decay, and the direct reconstruction of the invariant mass of the Higgs decay final states

Analysis Algorithm

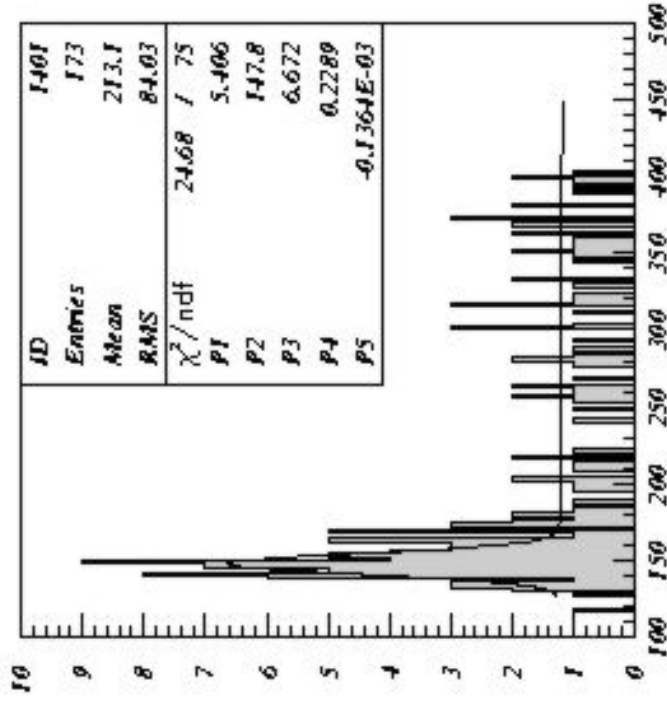
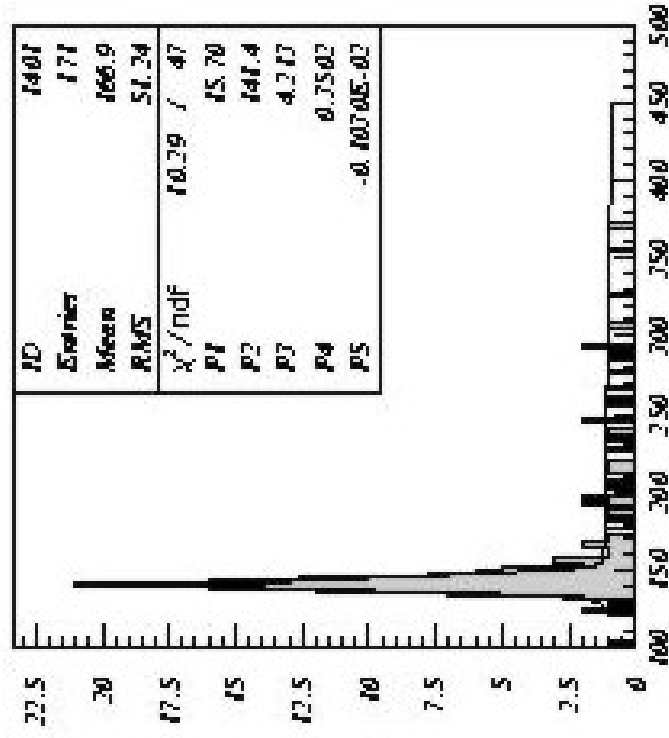
Statistics 100 -200 fb⁻¹

- Cuts:
- $P_t > 10$ GeV,
 - Angle Ω between leptons (Z^0) -0.85 - $+0.85$,
 - **Algorithm of single lepton search – cone $\pm 15^\circ$,**
 - Constraints to the Z^0 mass 85 - 95 GeV,



Preliminary Analysis

The Invariant Mass of Invisible System (the Recoil Mass Method)
Including the ISR

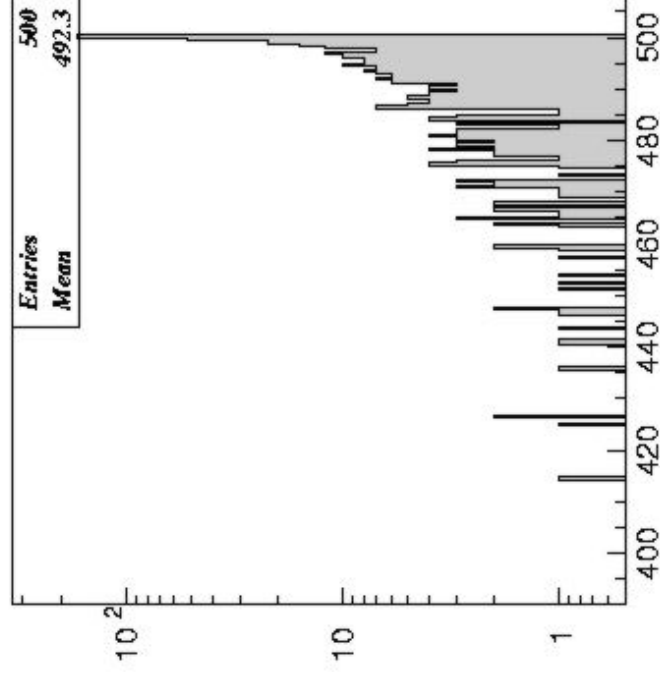


SM Higgs Signal Reconstruction $Z \rightarrow \mu+\mu-$ Final State 200 fb⁻¹
SM Higgs Signal Reconstruction $Z \rightarrow e+e-$ Final State 200 fb⁻¹

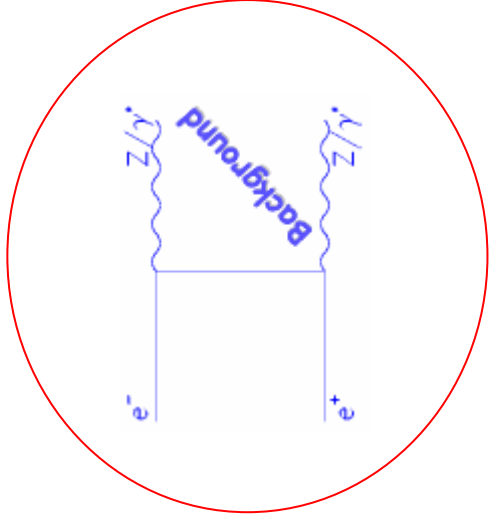
Experimental Environment at the TESLA LC

- Tunable e e collisions at $S = 0.5\text{TeV}$ - 1TeV , $L = 3\text{-}5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$,
- Polarisation: $P_{\text{electron}} \sim 80\%$, $P_{\text{positron}} \sim 60\%$
- “Giga-Z option for Z^0 –pole, W W threshold runs
- Low background environment (compared to LHC)
- **Beamstrahlung energy spread $\delta_B = 2.4\text{-}3.7\%$ (Accurate spectrum measurement is crucial to LC physics)**

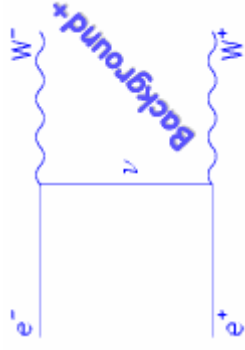
Full MC simulation included:
realistic **beam strahlung** processes on
base **CIRCE**- Beam Spectra for Simulating
Linear Collider Physics,



Background Processes



$$\sigma = 5.31 \times 10^2 \text{ fb}$$



$$\sigma = 7.53 \times 10^3 \text{ fb}$$

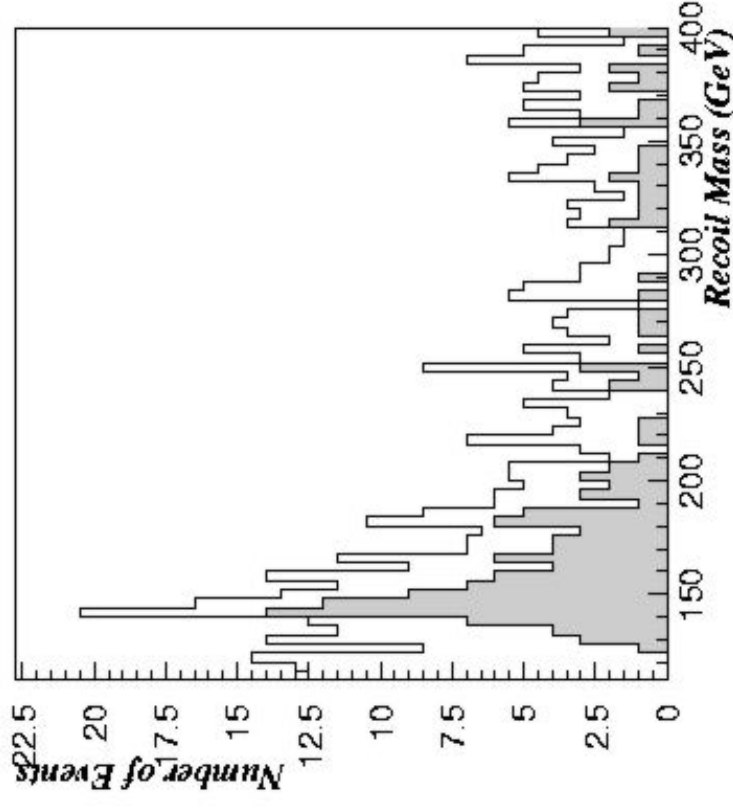


$$\sigma = 1.38 \times 10^4 \text{ fb}$$

Background statistics was generated by Pythia according cross sections

Preliminary Analysis

The Invariant Mass of Invisible System (the Recoil Mass Method)
Including the ISR and Beamstrahlung, and correspondent background processes



SM Higgs Signal Reconstruction $Z \rightarrow \mu+\mu-$ Final State 100 fb^{-1}

Brahms TESLA Linear Collider Simulation and Reconstruction

Plans

- Test the LCIO interface for G4 (Mokka) and RERECO .
- OO base for Brahms reconstruction frame for tracking.
- Study of the Sensitivity of SM Higgs at TESLA LC