SM Higgs Sensitivity Study

LCWS
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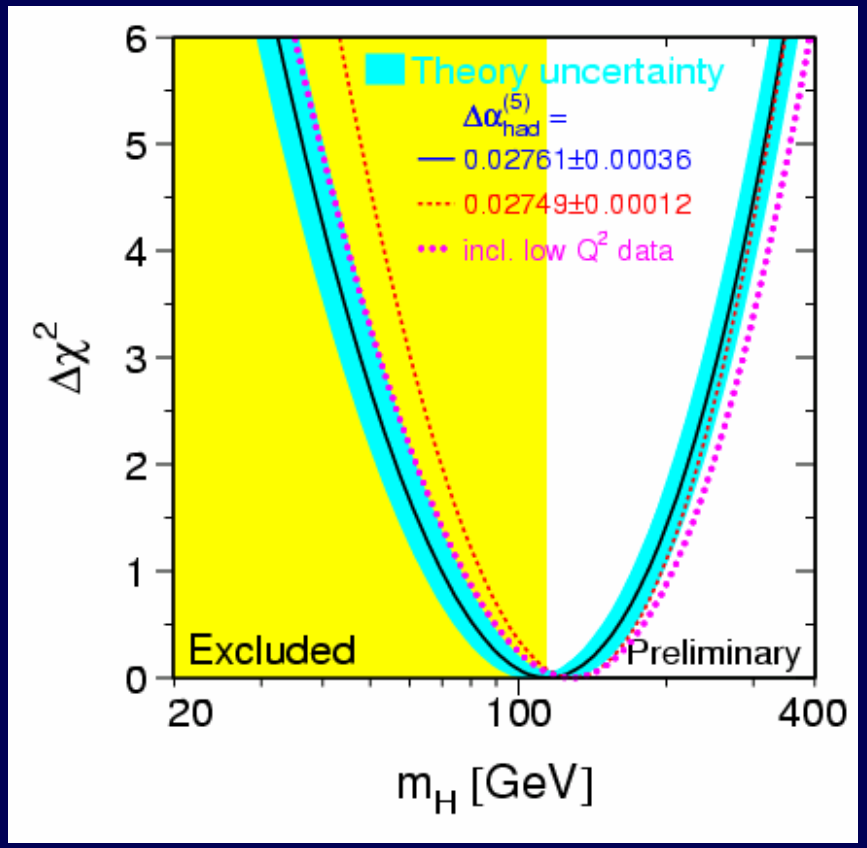
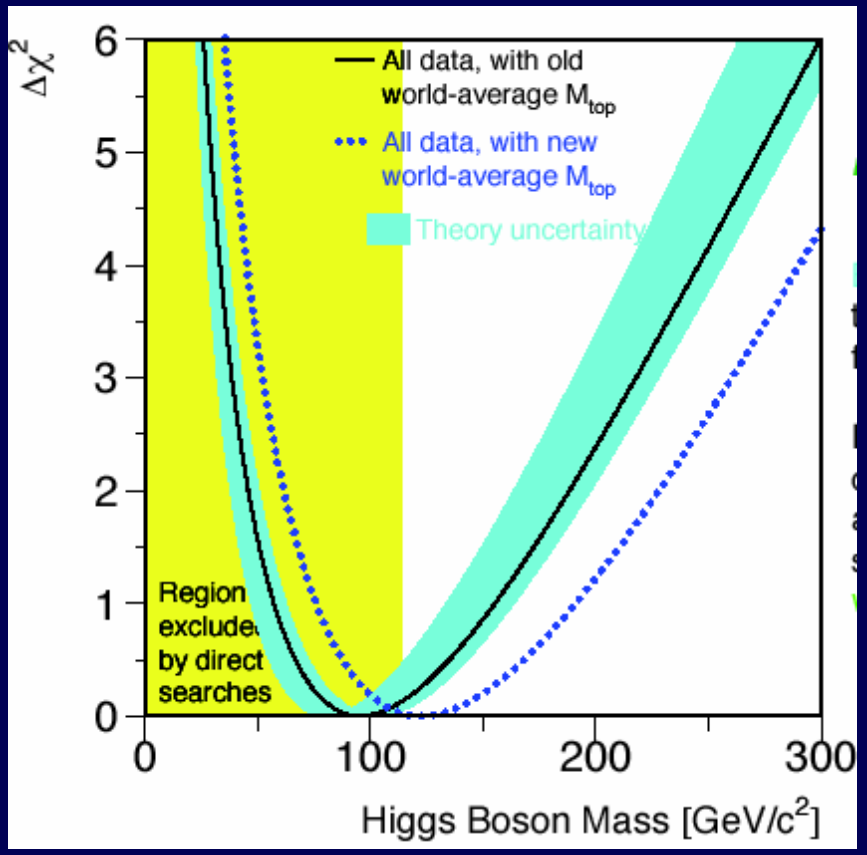
SM Higgs Study at ILC

- The Higgs boson plays the central role in the electroweek symmetry breaking and the generation of masses for quarks, leptons, and vector bosons.
- In the Standard Model, Higgs is scalar particle which couples to each fermion and boson species proortionaly to its mass.
- If the Standard Model is not correct, the unexpected could come at many different points.

SM Higgs Study at ILC





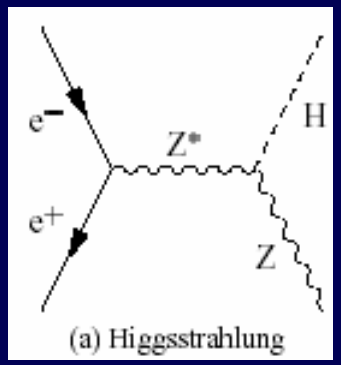
The Global Fit: Limits on the Higgs mass (Robert Clare talk)

SM Higgs Boson Study at ILC

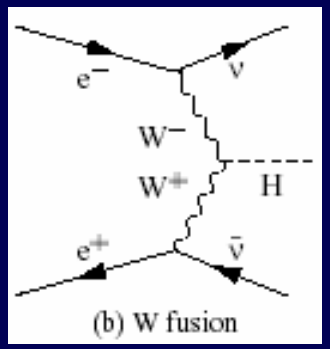
The main goal this Study is define the Significance of Detecting of SM Higgs at ILC on base of full MC simulation including realistic spectrometer on base BRAHMS(G3), Mokka(G4)-, and full reconstruction chain, with the Particle Flow Algorithm

SM Higgs

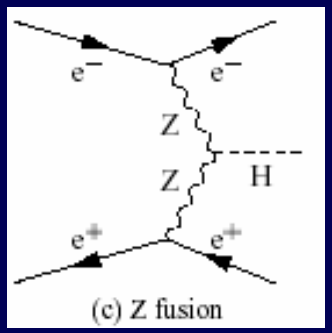
Dominant processes for the SM Higgs Boson at 500 GeV Center Mass Energy and Higgs mass 120-180 GeV is Higgsstrahlung process, others are by fusion of WW and ZZ bozons.



(a) Higgsstrahlung



(b) W fusion



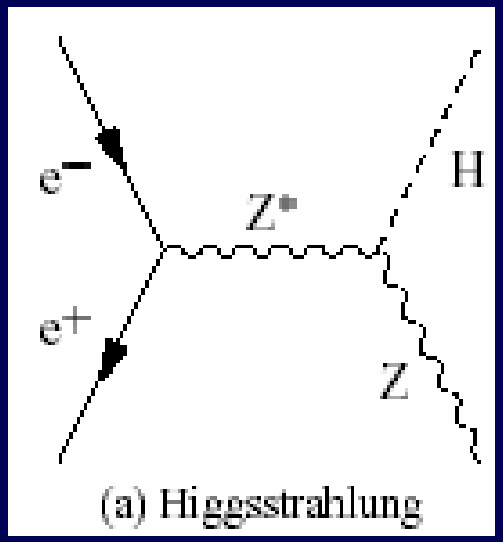
(c) Z fusion

SM Higgs in Higsstrahlung (Generator)

Pythia 6. – version

- CM Energy is 500 GeV...
- Higgs mass is 140 GeV...
- ISR processes is included,
- Z^0 is forced decay to l^+,l^- (ee, mm),
- h^0 is forced decay to b, bbar (for further investigations),

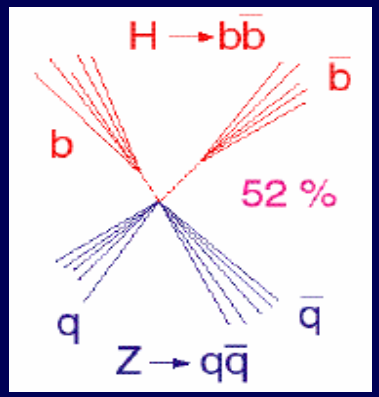
LCIO Interface Pythia/Brahms HEPEVT format based.

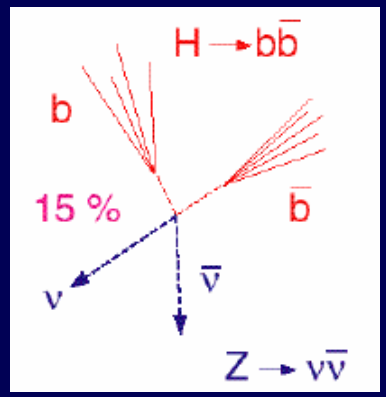


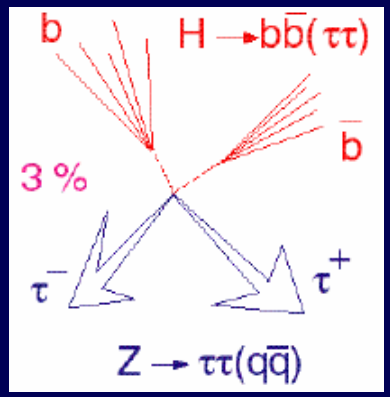
SM Higgs Strahlung Final States

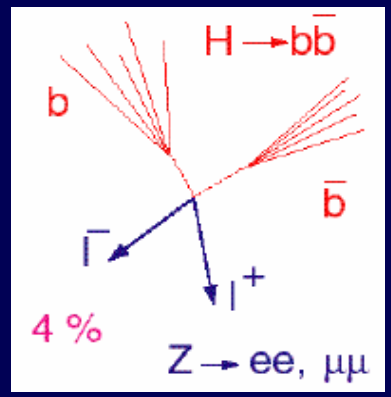
Final States with Good Sensitivity to SM Higgs Boson:
at CMS 500 GeV and Higgs mass 120-180 GeV

$h^0 \to$	$b\bar{b}$	WW	$\tau\bar{\tau}$	$c\bar{c}$	gg
	77%	6.8%	6.4%	4.9%	4.1%
$Z^0 \to$	$q\bar{q}$	$\nu\bar{\nu}$	ee	$\mu\mu$	$\tau\bar{\tau}$
	70%	13.4%	3.4%	3.4%	3.4%









Method of Analysis

Analysis of the Invariant Mass of Invisible System

(the Recoil Mass):

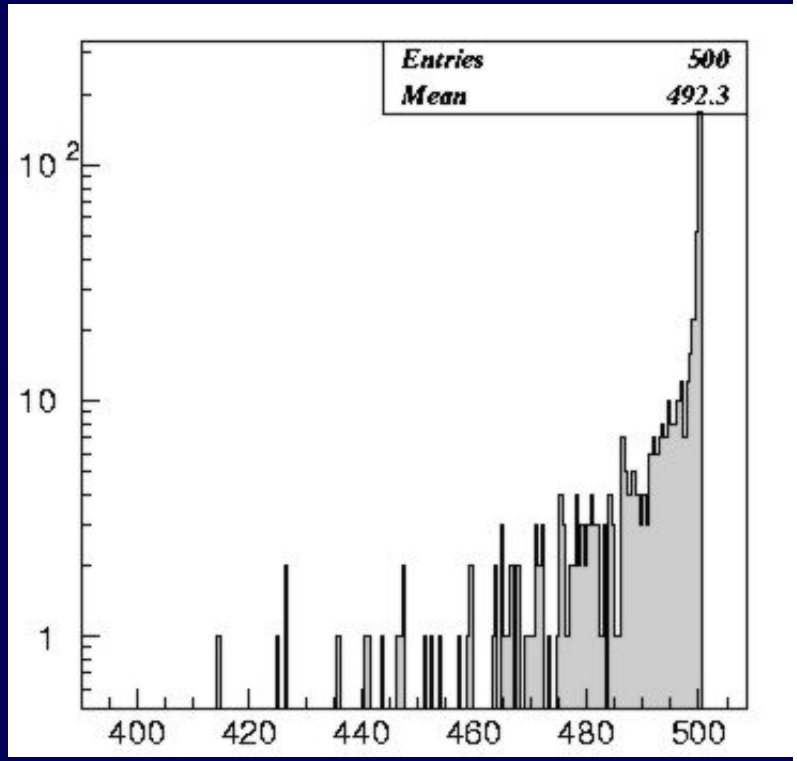
The recoil mass is determined by requiring energy and momentum conservation and by constraining the invariant mass of the visible system to the Z mass.

$$m^2_{rec} = s - 2\sqrt{s}(E_{l^+} + E_{l^-}) + m_z^2$$

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

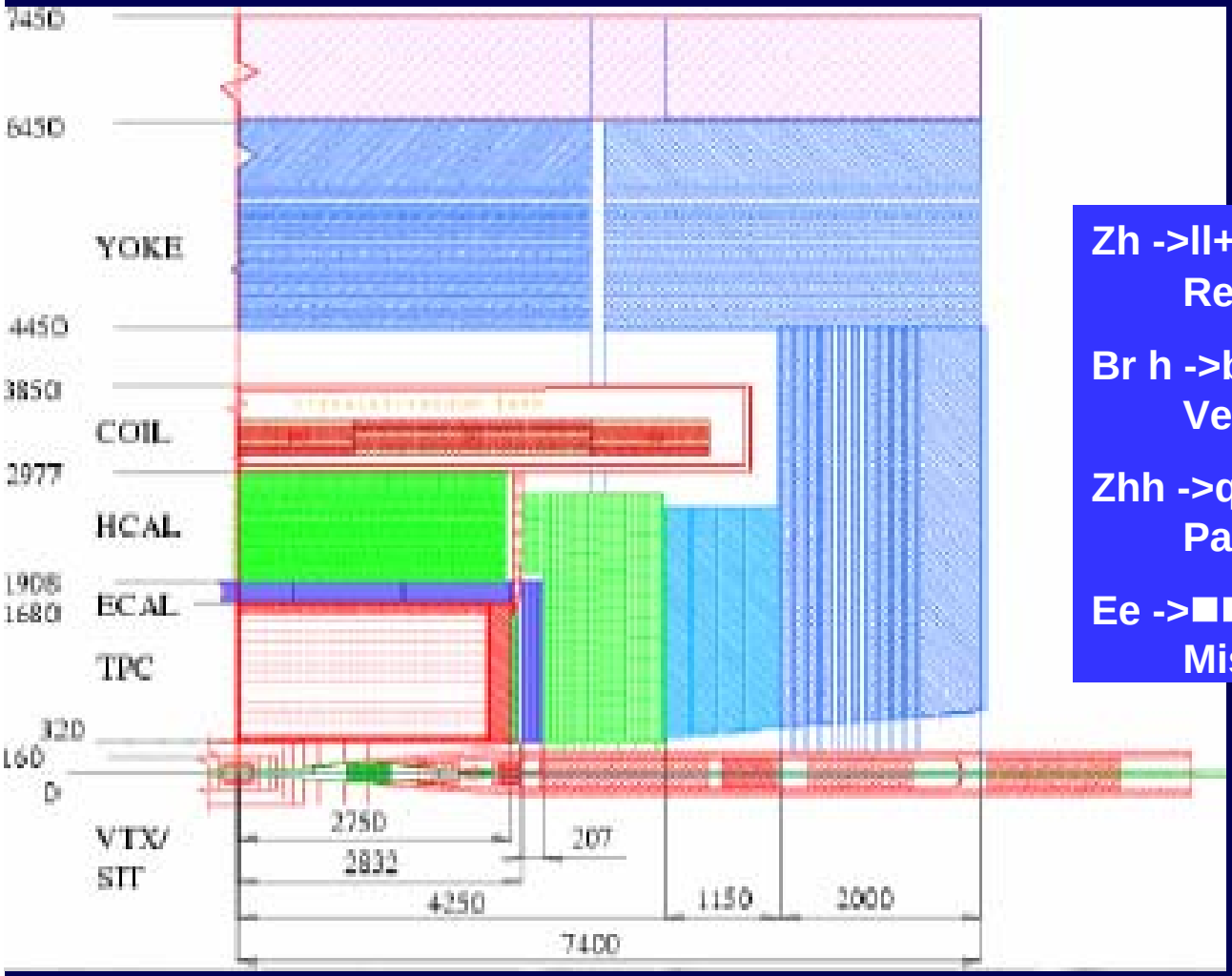
Experimental Environment at the ILC

- Tunable e e collisions at S = 0.5TeV-1TeV, L = 3-5x10^34 cm^-2 s^-1,
- Polarisation: P_electron ~80%, P_positron ~60%
- “Giga-Z option for Z^0 –pole, W W threshold runs
- Beamstrahlung energy spread delta_B=2.4-3.7 % (Accurate spectrum measurement is crucial to LC physics)



Full Simulation included the realistic beam strahlung processes on base CIRCE – Beam Spectra Simulation.

ILC Detector (LCD)



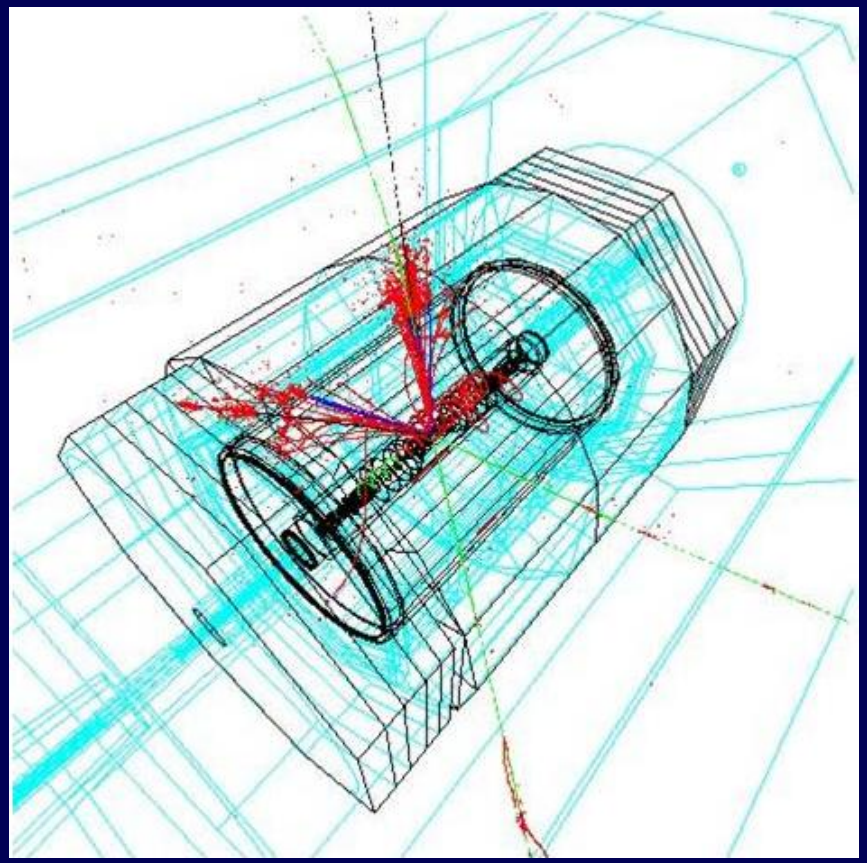
Zh ->ll+h - Precise momentum Resolution

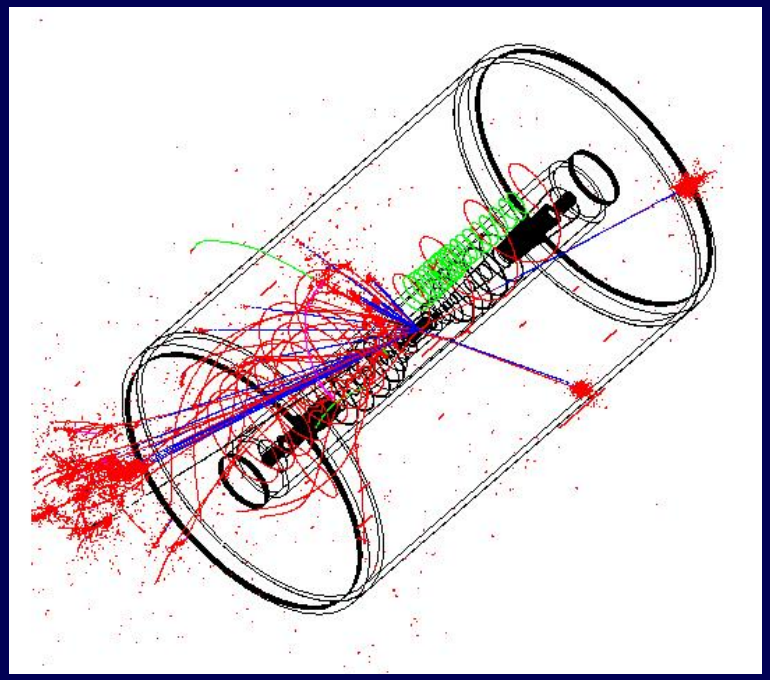
Br h ->bb,cc,gg - Exelent Vertexing/Flavor Identification

Zhh ->qqbbbb - Exelent Calorimetry, Particle Flow Algorithm;

Ee ->■■ h - Exelent Hermeticity, Missing Mass Resolution

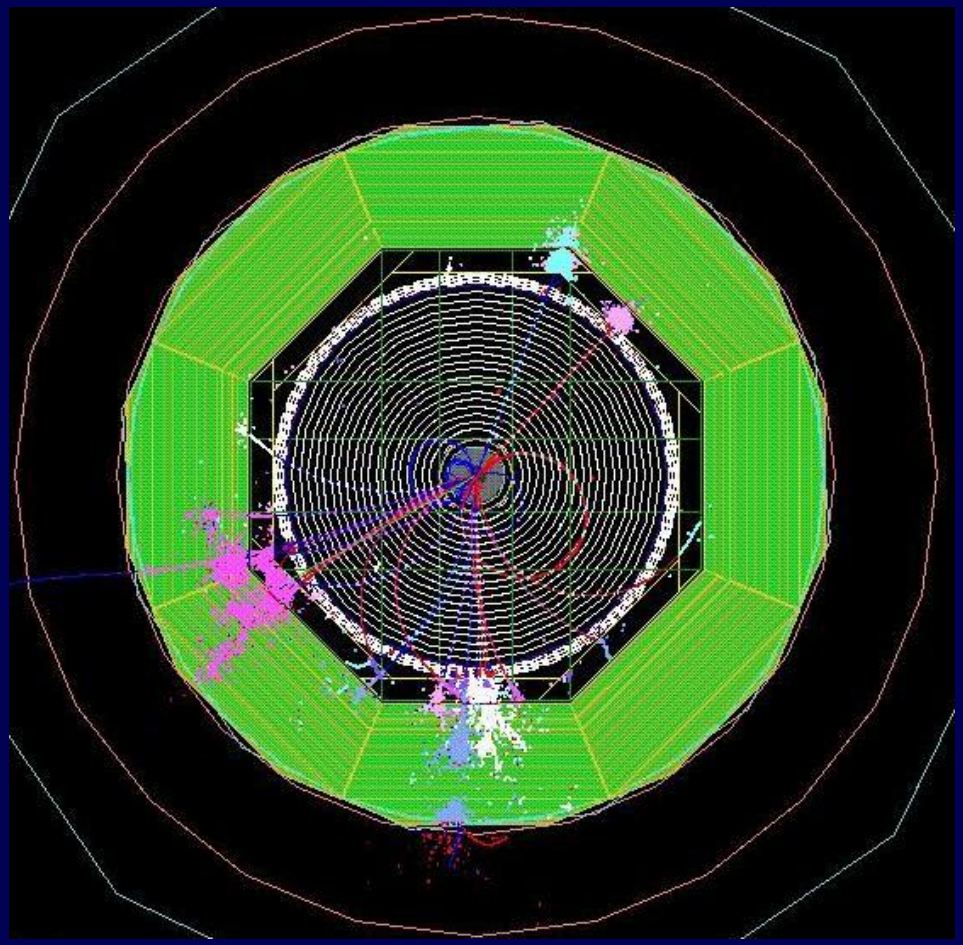
SM Higgs Simulations





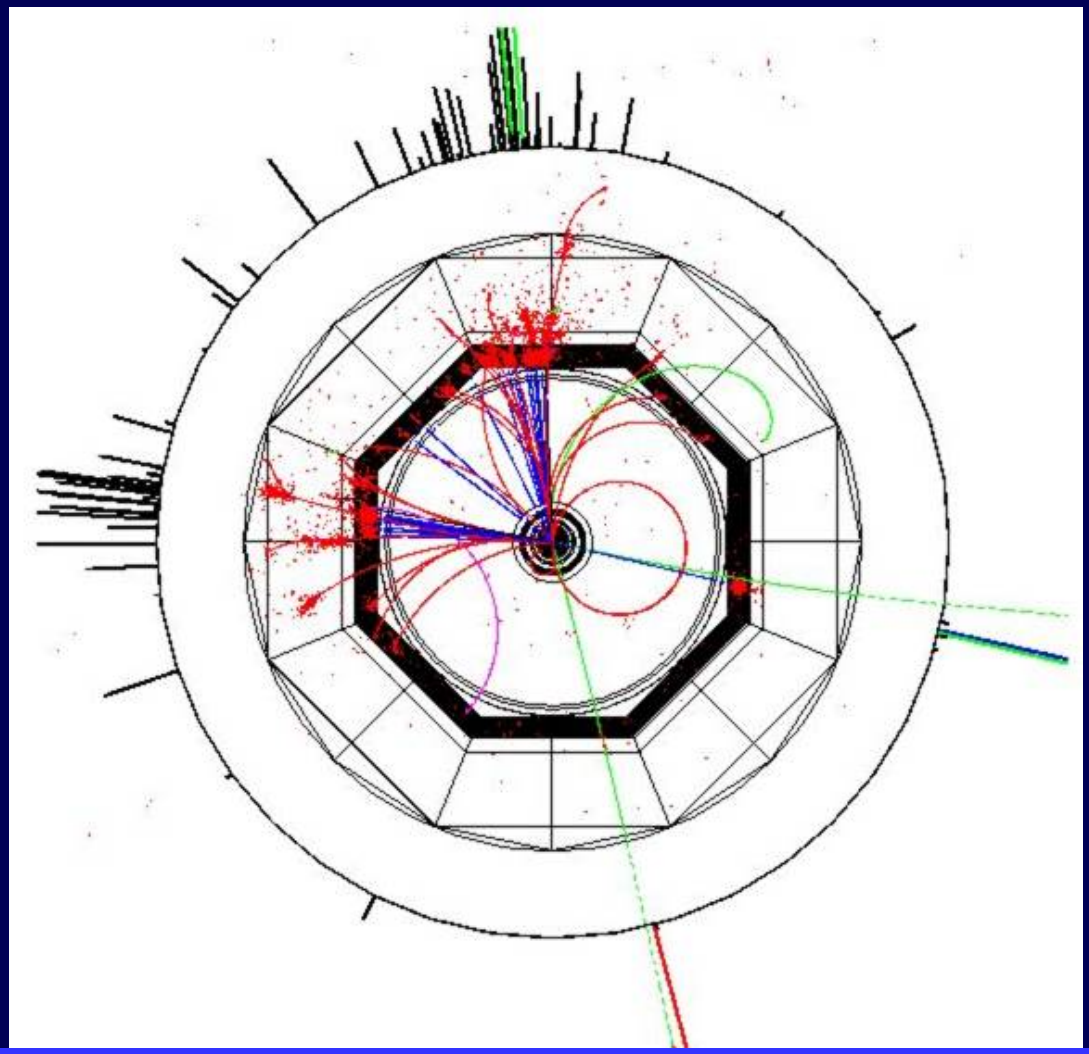
Event Display of Full Simulation of the h^0 ->bbbar, Z^0 -> mumu, ee

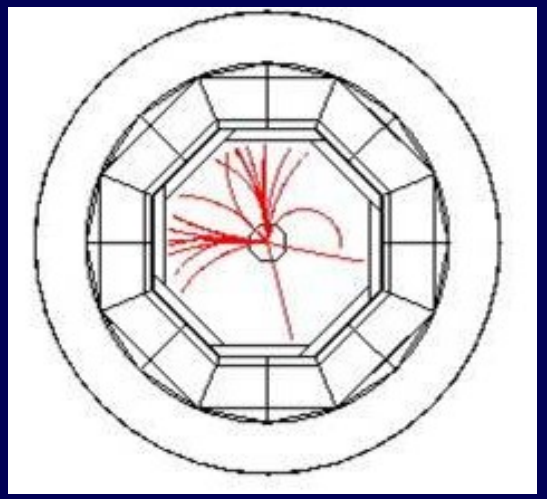
SM Higgs as in Mokka (G4) Frame

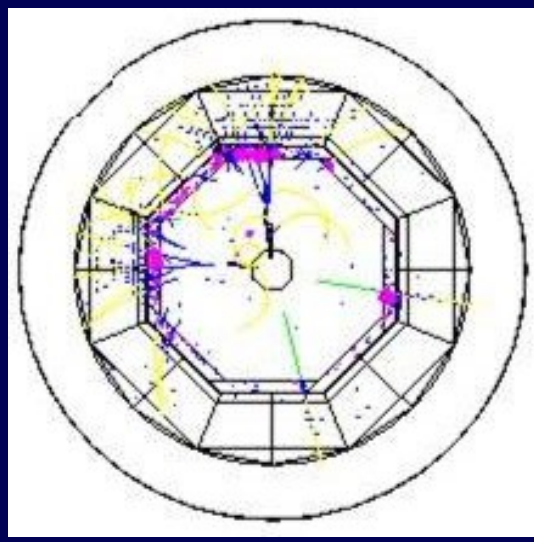


Event Display of Full Simulation of the h^0 Z^0 -> b bbar , ee

Particle Flow in Reconstruction

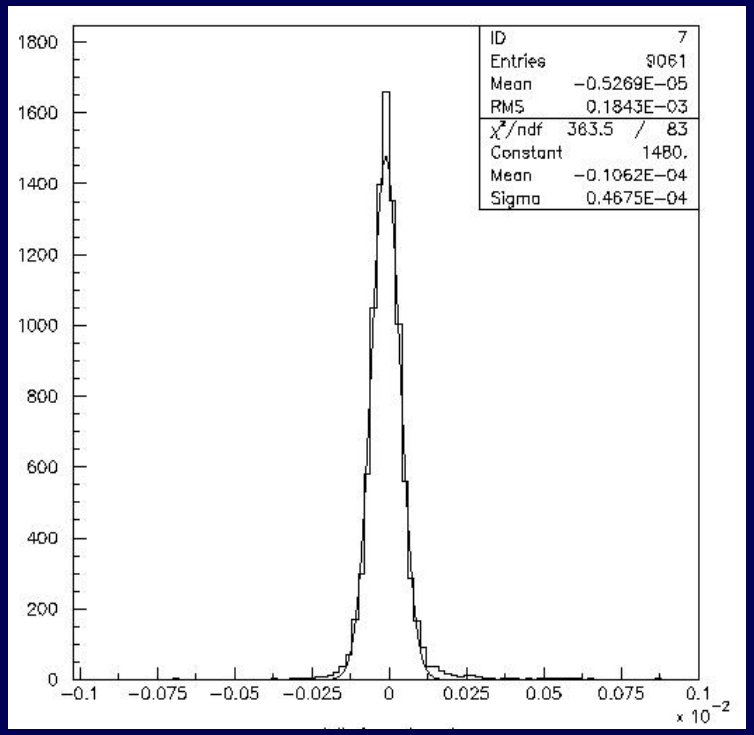


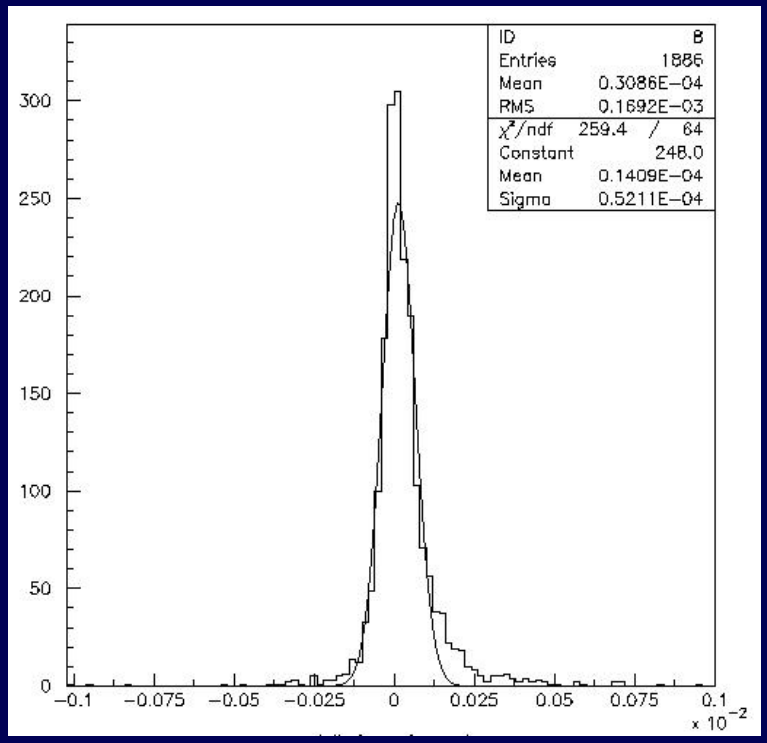




Event Display of Full Simulation of the $h^0 Z^0$ -> b bbar $\mu\mu$ and Particle Flow Objects

Reconstruction RERECO

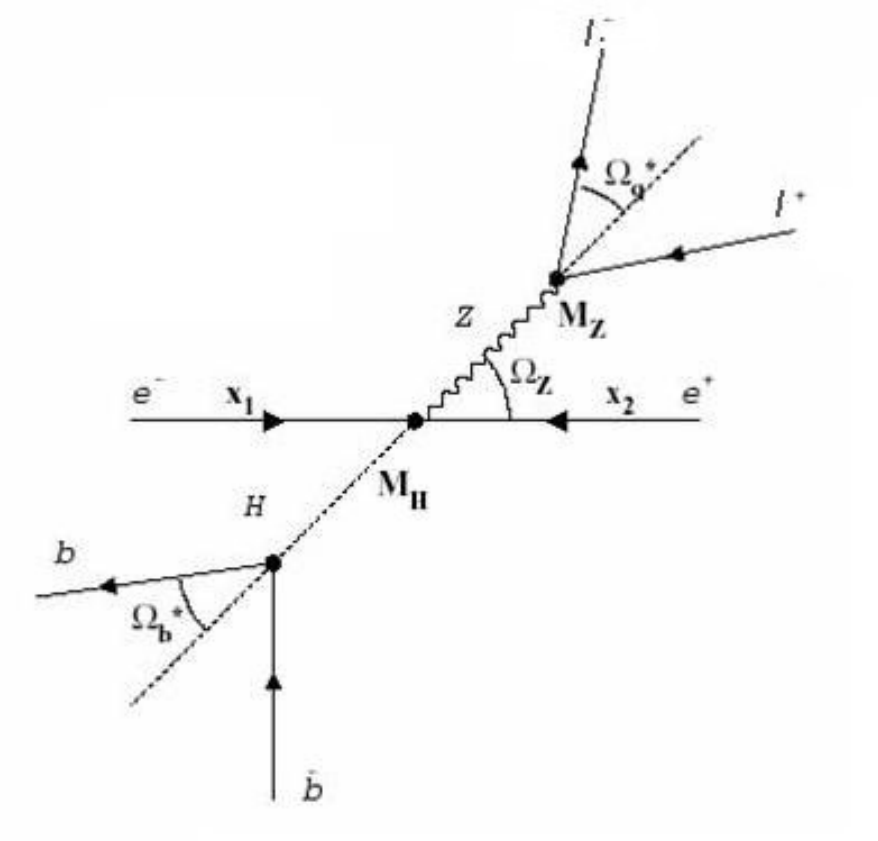




Momentum reconstruction resolution for barel and endcup for muons from Z

Central region 4.7×10^{-5}, Forward region 5.5×10^{-5}

Analysis Algorithm



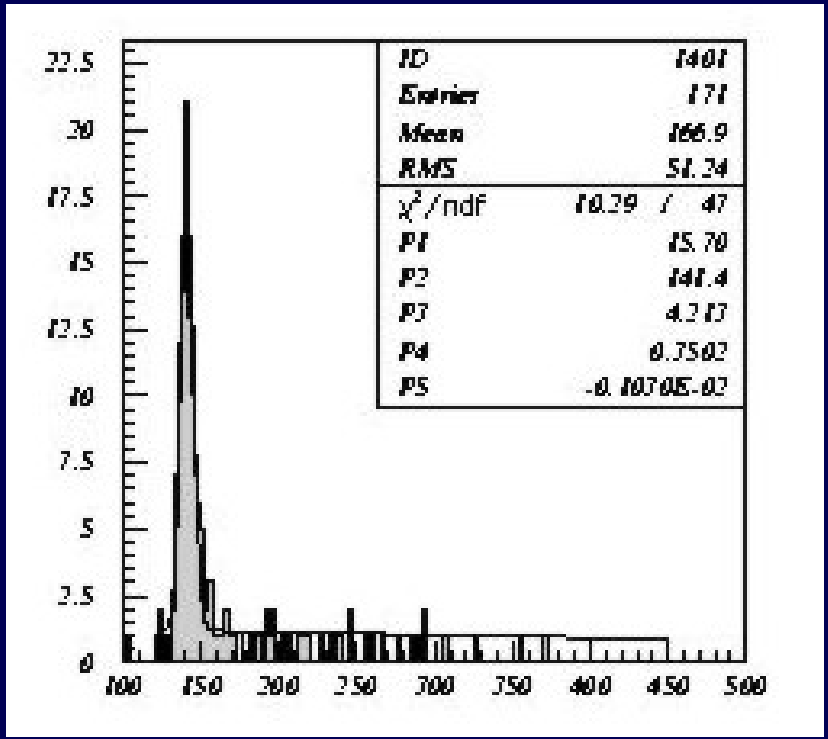
Cuts:

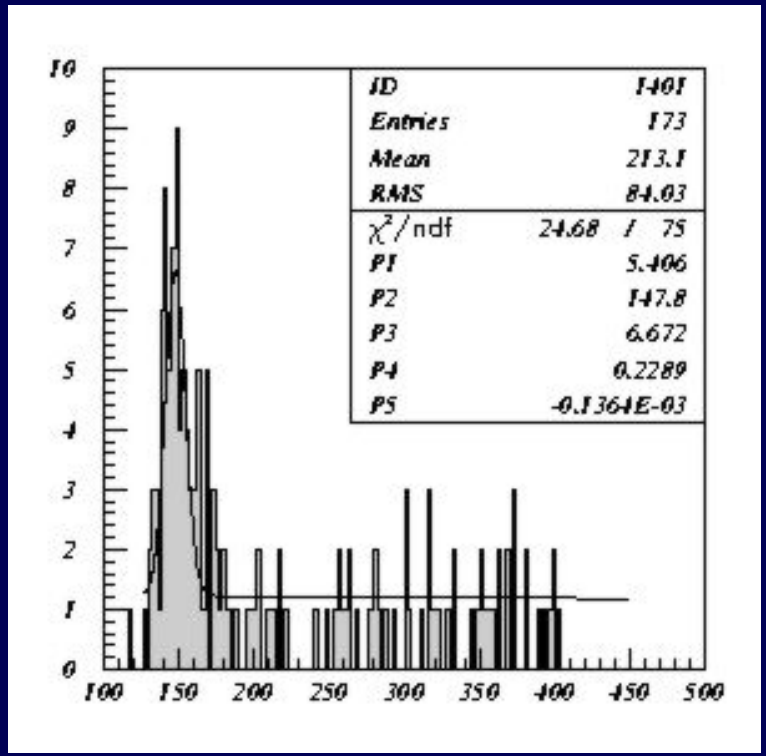
- Algorithm of single lepton search – cone +/- 15º ,
- A lepton candidate must have an anergy >10 GeV,
- At least 2 leptons candidates in the event,
- The polar angle W between leptons (Z^0) cos -0.85 - +0.85,
- The invariant of the lepton pairs (constraints to the Z^0) lie within -+ 5 GeV of the Z mass.

The signal Efficiency is 55% for 500 GeV CMS

Preliminary Analysis

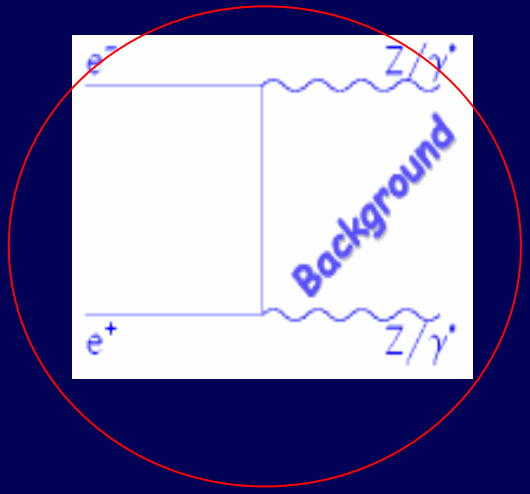
The Invariant Mass of Invisible System (the Recoil Mass Method)
Including the ISR

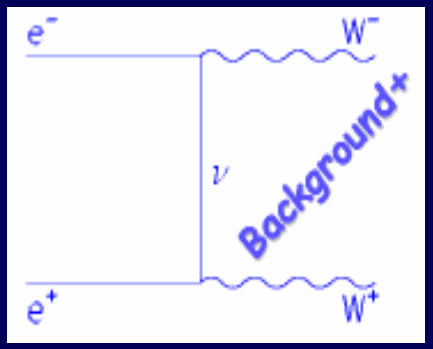


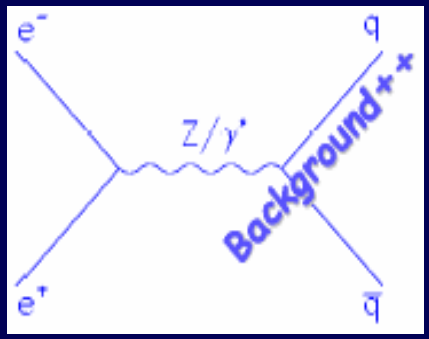


SM Higgs Signal Reconstruction Z -> mu+mu- Final State 100 fb $^{-1}$
SM Higgs Signal Reconstruction Z -> e+e- Final State 100 fb^{-1}

Background Processes







$\sigma = 5.31 \times 10^2$ fb

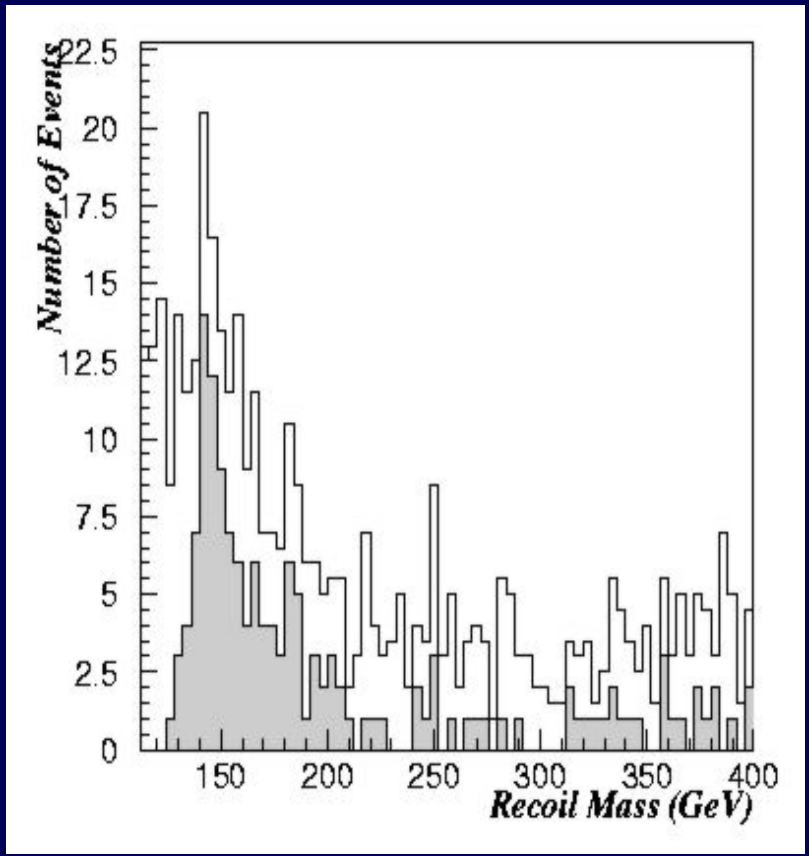
$\sigma = 7.53 \times 10^3$ fb

$\sigma = 1.38 \times 10^4$ 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, Beamstrahlung, and correspondent background processes



SM Higgs Signal Reconstruction Z -> m+m- Final State 100 fb $^{-1}$

Interpretation of the Statistics

- Confidental Level Method (CL_s) developed at LEP

Status and Conclusions

- Analysis frame exist
- Statistics is runing for different mass of Higgs and CMS
- ANALYSIS IS GOING ON