Measurement of Higgs Mass and Cross Section at NLC

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Monte Carlo Generator & Simulation

- MC Generator: PANDORA-PYTHIA V2.1

  $\Longrightarrow$ Thanks to Michael E. Peskin, Masako Iwasaki.

- Analysis Platform: JAVA Analysis Studio V2.2.1

  $\Longrightarrow$ Thanks to Tony Johnson, Mike Ronan.

- Fast MC with beam spot constraint

  $\Longrightarrow$ Thanks to Wolfgang Walkowiak.

- Measurement of higgs mass and cross section is based on fast MC sample.

- Detectors: LDMAR01(LD), SDMAR01(SD)

- $e^+e^- \rightarrow ZH \rightarrow e^+e^-X(\gamma),\ \mu^+\mu^-X(\gamma)$

  $\sqrt{S} = 350,\ 500$ GeV and $\mathcal{L} = 500 fb^{-1}$

  $M_H = 115,\ 120,\ 140,\ 160$ GeV

Signal and Background

- Signal: $e^+e^- \rightarrow ZH \rightarrow e^+e^- X(\gamma),\ \mu^+\mu^- X(\gamma)$

$\sqrt{S}(GeV)$	M_H	σ(fb)	Exp. Events
350	115	5.52	2760
350	120	5.39	2695
350	140	4.57	2285
350	160	3.78	1890
500	115	2.66	1330
500	120	2.55	1275
500	140	2.35	1175
500	160	2.15	1075

- Background: ZZ, WW

$\sqrt{S}(GeV)$	BKGD	σ(fb)	Exp. Events
350	ZZ	878.4	439K
500	ZZ	561.9	281K
350	WW	21.8K	11M
500	WW	14.3K	7M

Selection Cuts

1). Energy of $l^{\pm}$ from Track: $E_l > 10\text{GeV}$

2). Polar angle of $l^{\pm}$: $|\cos(\theta_l)| < 0.9$

3). No. of $l^{\pm}$ satisfy 1) & 2): $N_l \geq 2$

4). Inv. mass of l^+l^-: $|M_{l^+l^-} - M_{Z^0}| < 5\text{GeV}$

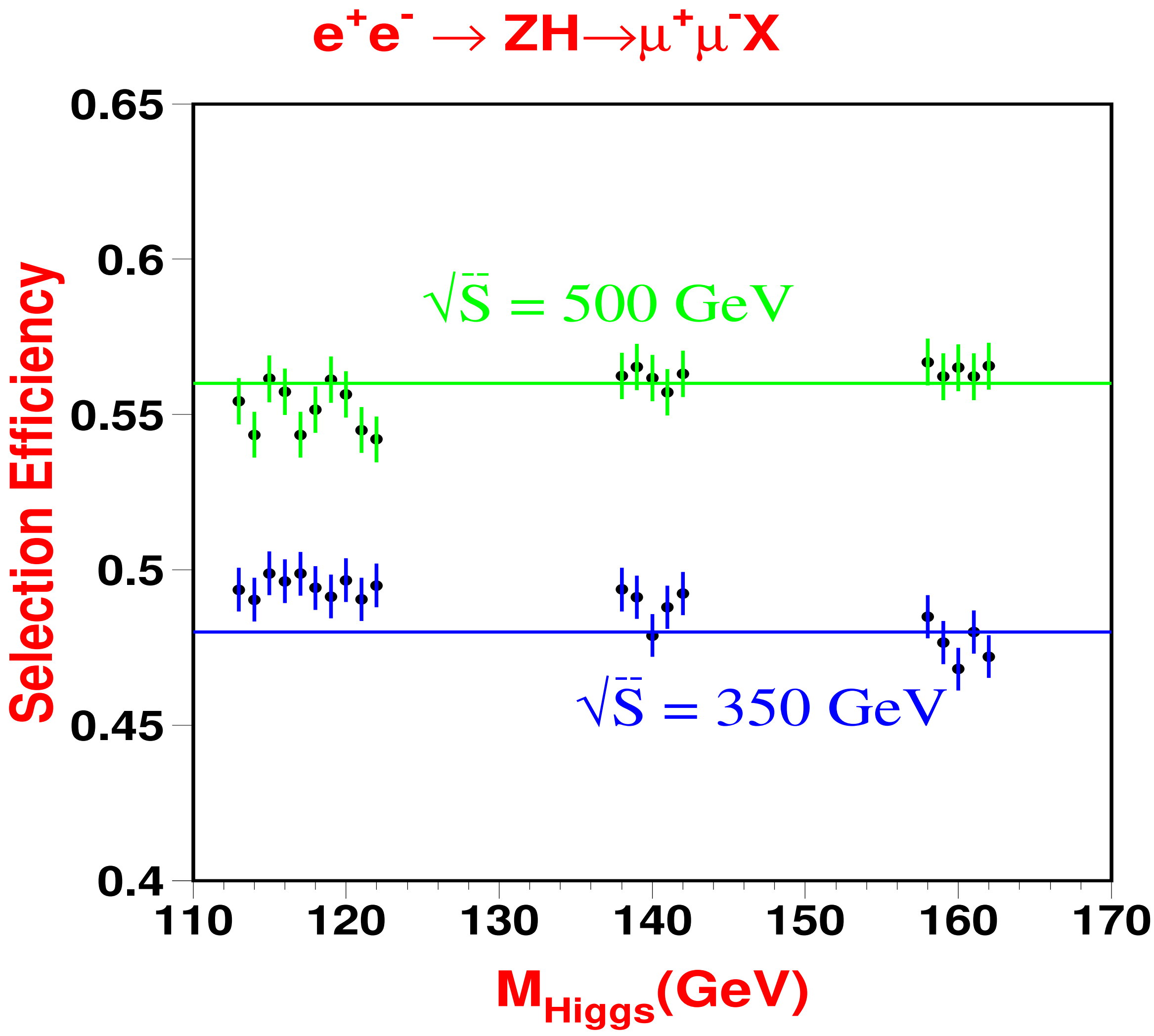
5). Polar angle of $Z^0(l^+l^-)$: $|\cos(\theta_{l^+l^-})| < 0.6$

6). Angle between l^+l^-: $\cos(\theta_{l^+\leftrightarrow l^-}) > -0.7$

Recoil mass of l^+l^- system:

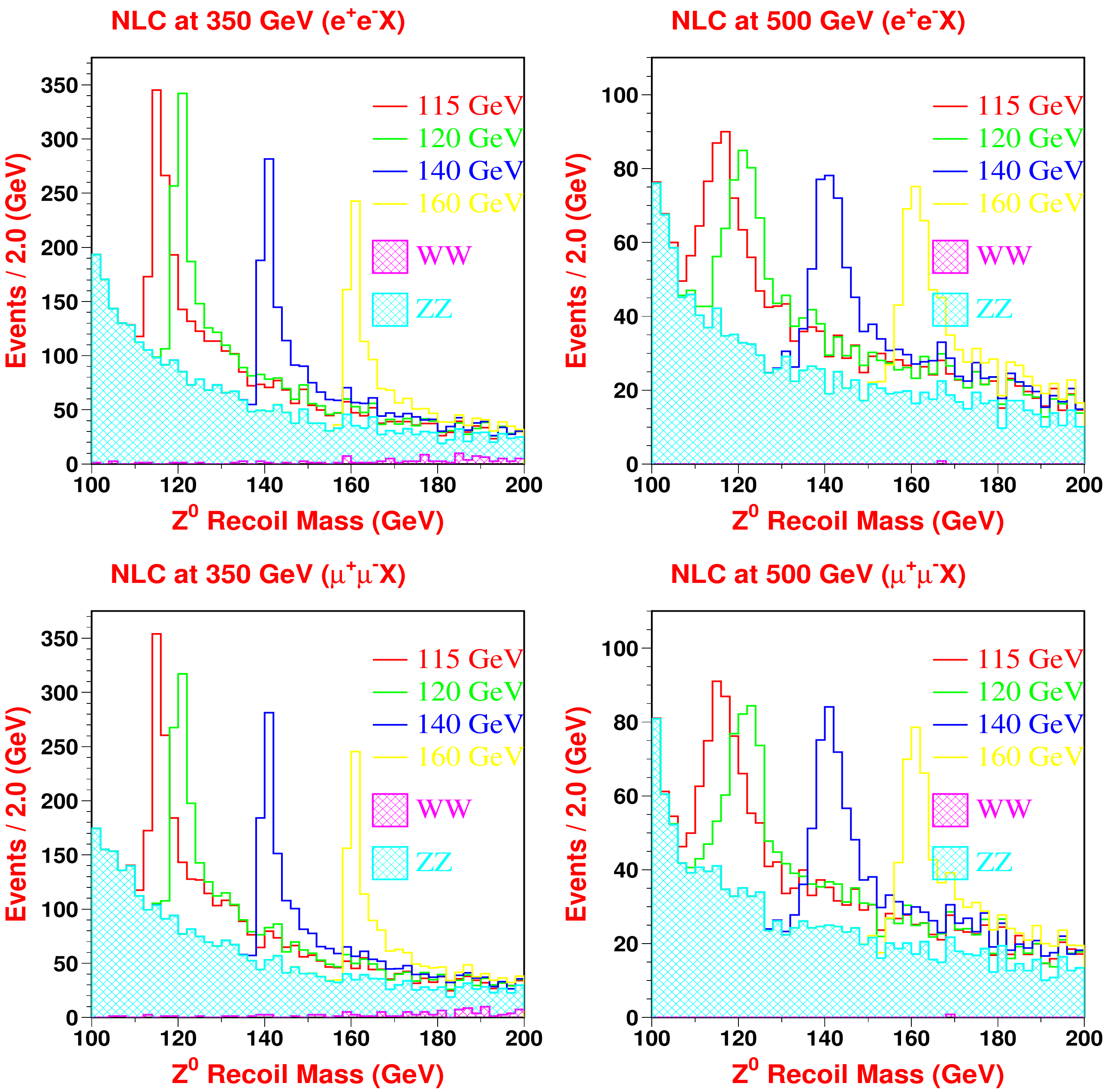
$$M_H = \sqrt{S - 2 \bullet \sqrt{S} \bullet E_{l^+l^-} + M^2_{l^+l^-}}$$

Selection Efficiency



- Selection efficiencies of e & μ are similar.

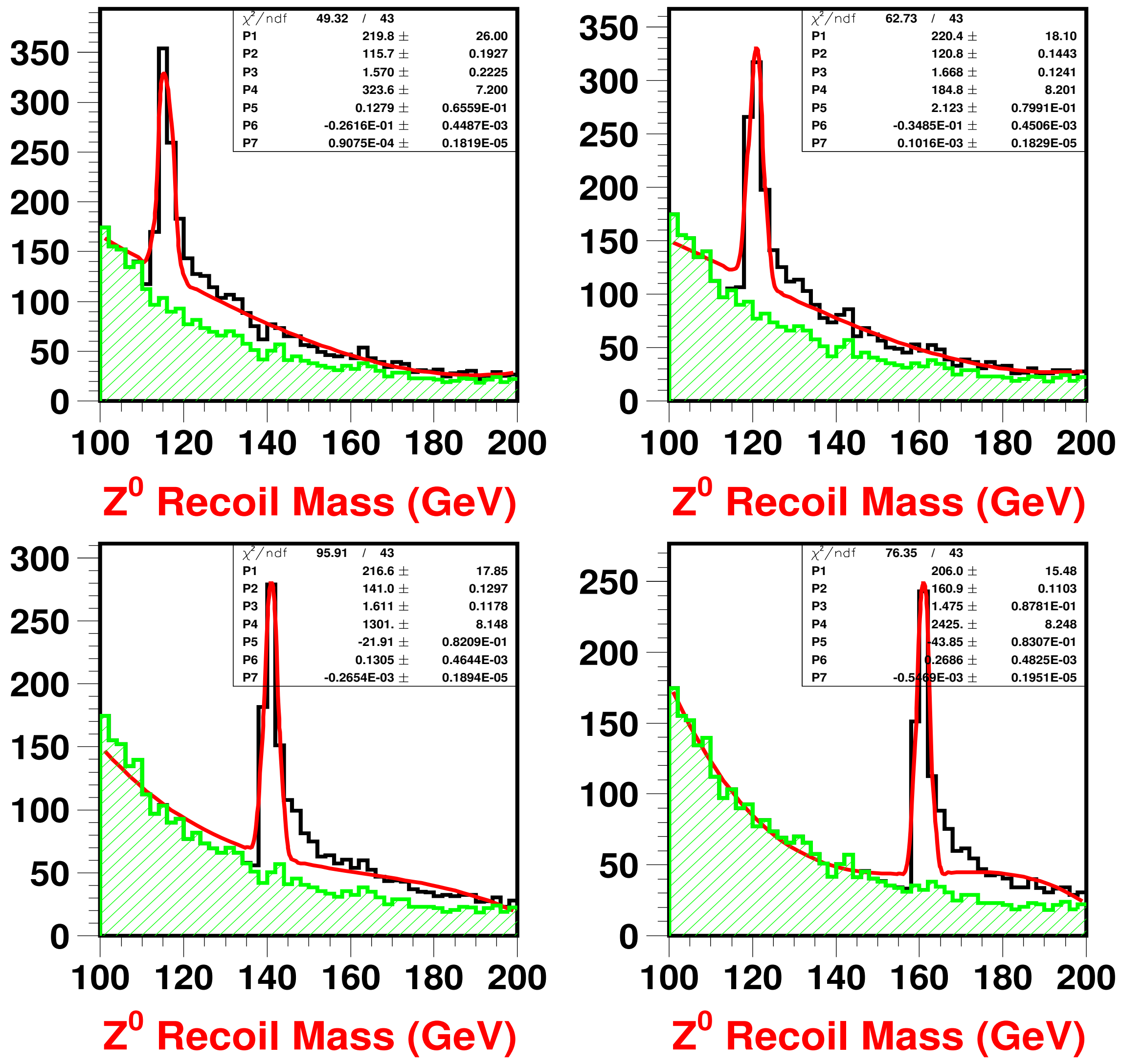
Higgs Mass Distr. After Selection



- $e^+e^- \to ZH \to e^+e^-X(\gamma),\ \mu^+\mu^-X(\gamma)$
- Distributions of backgrounds and signal with different higgs mass hypothesis.

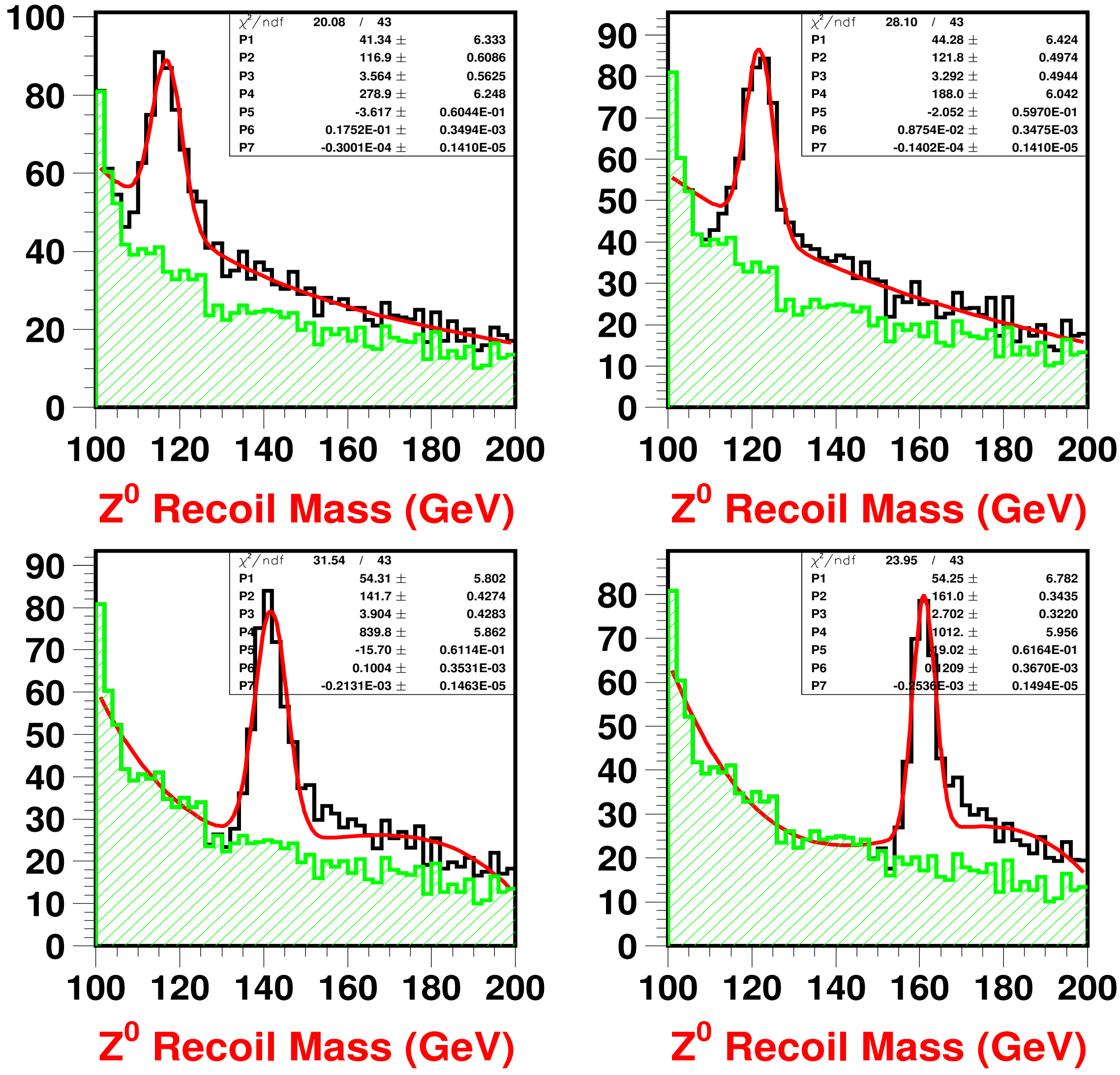
Measurement of Higgs Mass

NLC at 350 GeV, ZH $\rightarrow \mu^+\mu^-X$



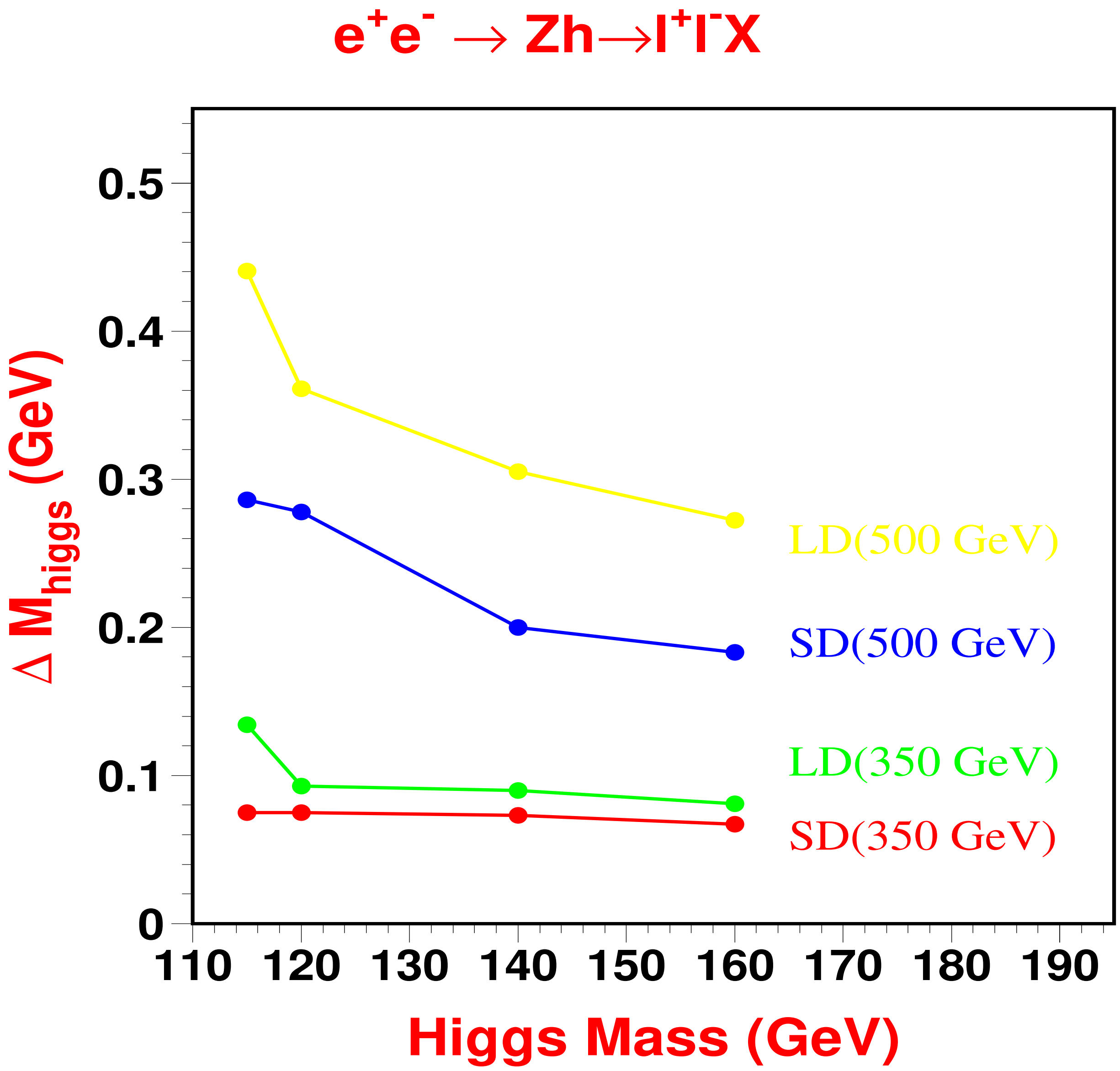
- Fitting Function: Gaussian + Polynomial(P3)

NLC at 500 GeV, ZH $\rightarrow \mu^+\mu^- X$



- Fitting Function: Gaussian + Polynomial(P3)

Accuracy of Higgs Mass

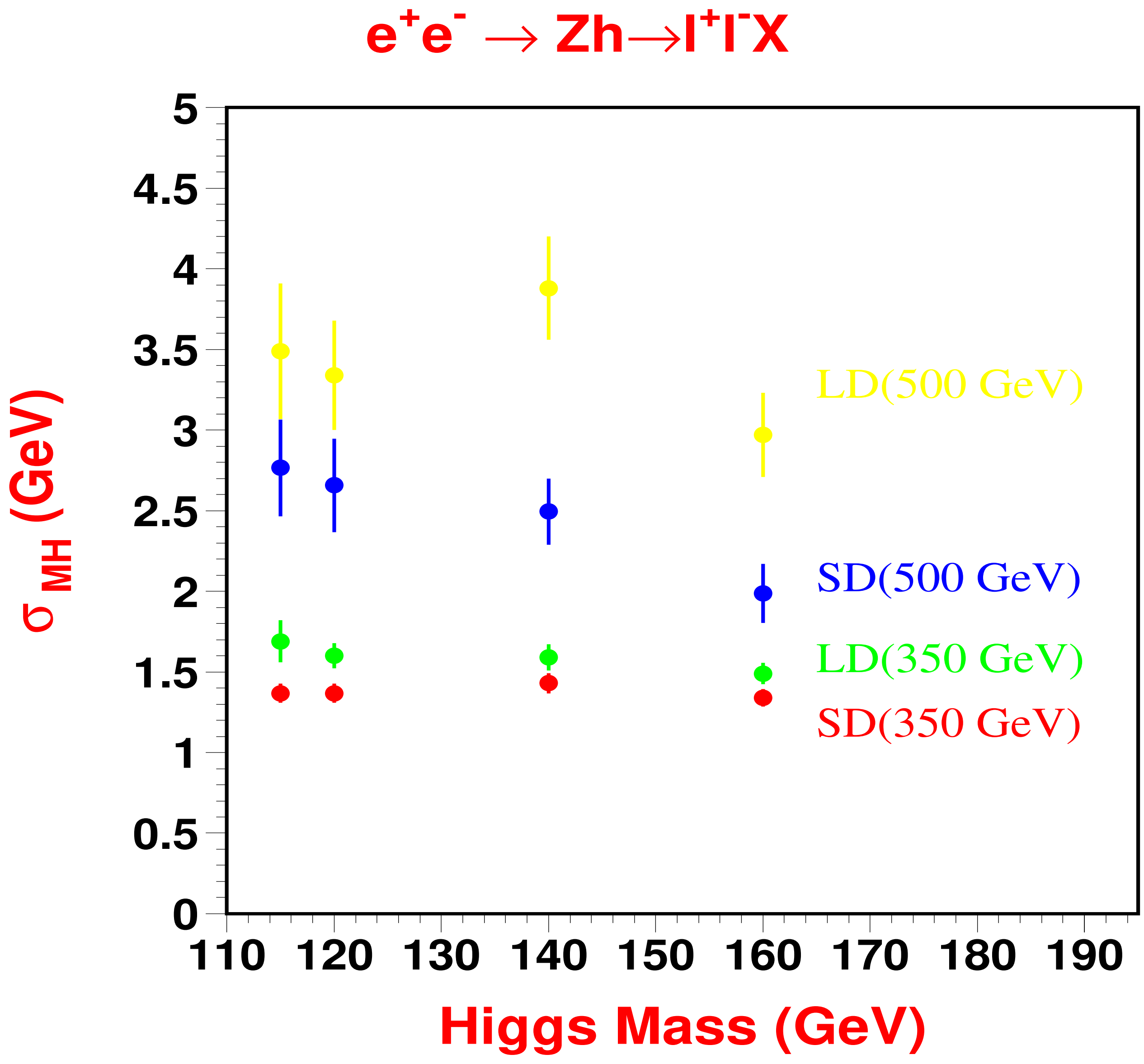


- Gaussian + Polynominal(P3) fit:

  $\Longrightarrow \Delta M_{higgs}$ at 350 GeV: $\sim$ 100 MeV.

  $\Longrightarrow \Delta M_{higgs}$ at 500 GeV: 300 $\sim$ 400 MeV.

Resolution of Higgs Mass

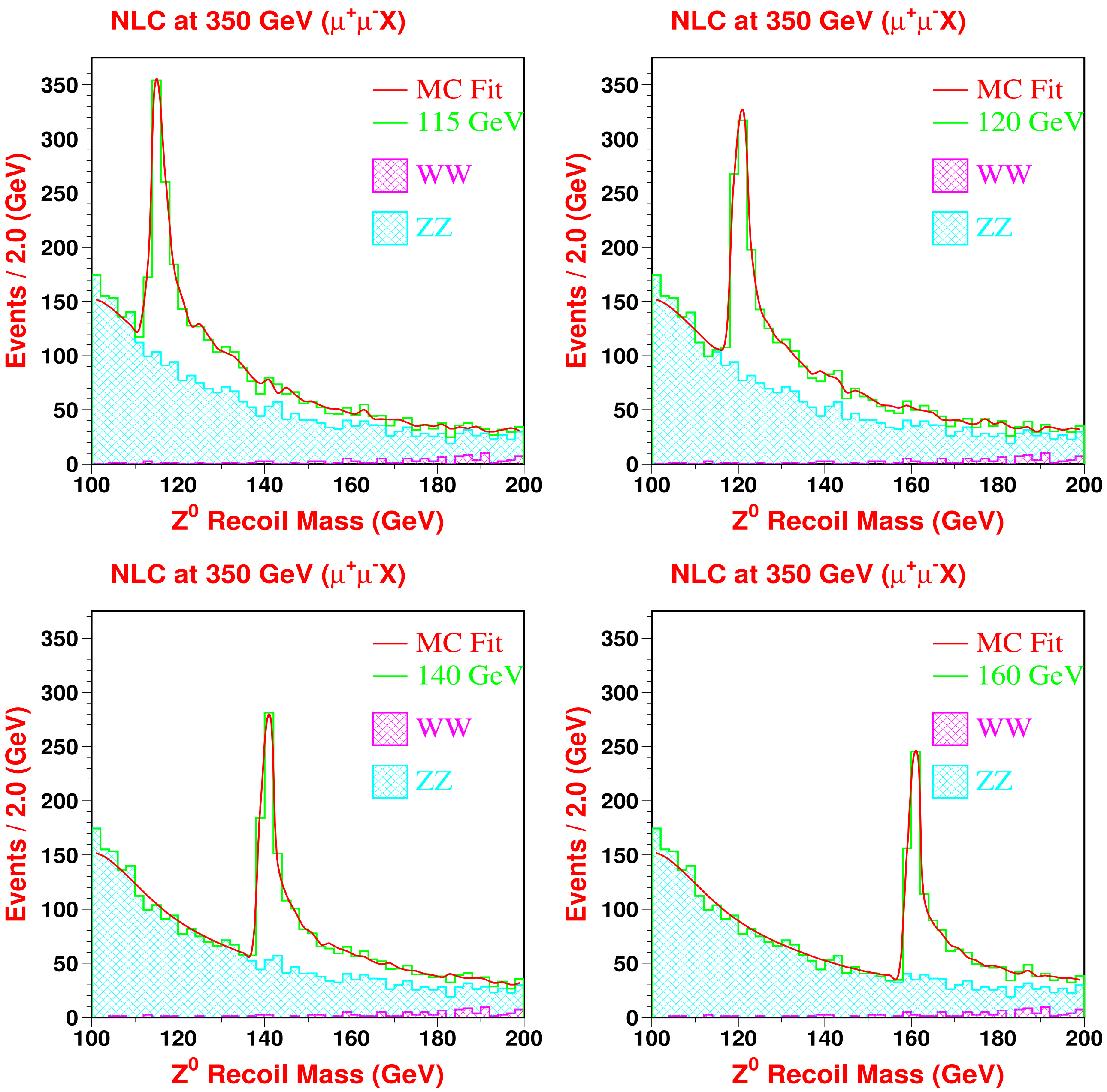


- Gaussian + Polynominal(P3) fit:

  $\Longrightarrow \sigma_{M_{higgs}}$ at 350 GeV: $\sim$ 1.6 GeV.

  $\Longrightarrow \sigma_{M_{higgs}}$ at 500 GeV: $\sim$ 3.0 GeV.

Measurement of Higgs Mass

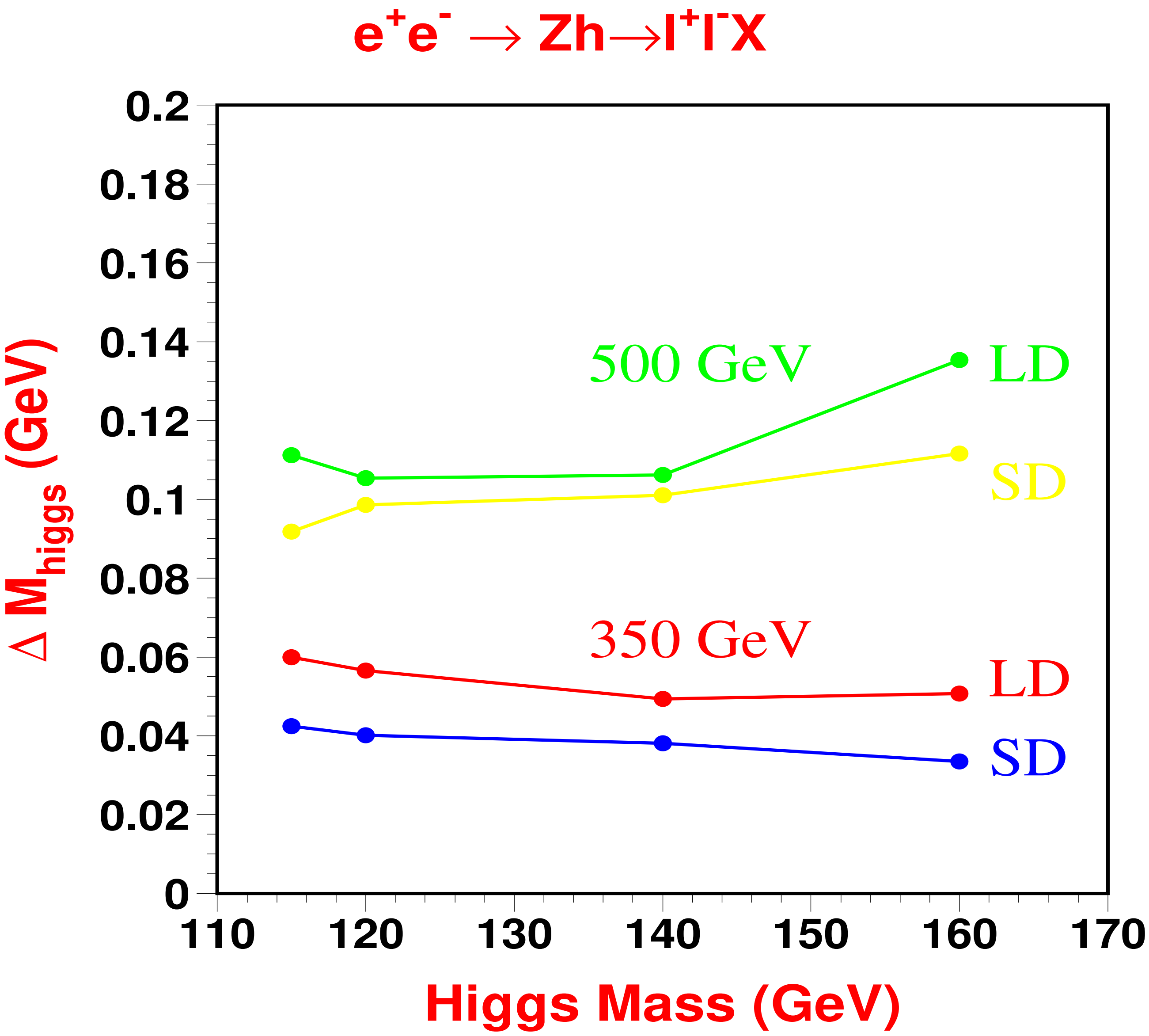


- Monte Carlo Interpolation: 2-parameter fit

  $\Longrightarrow$ Higgs mass

  $\Longrightarrow$ Cross section

Accuracy of Higgs Mass

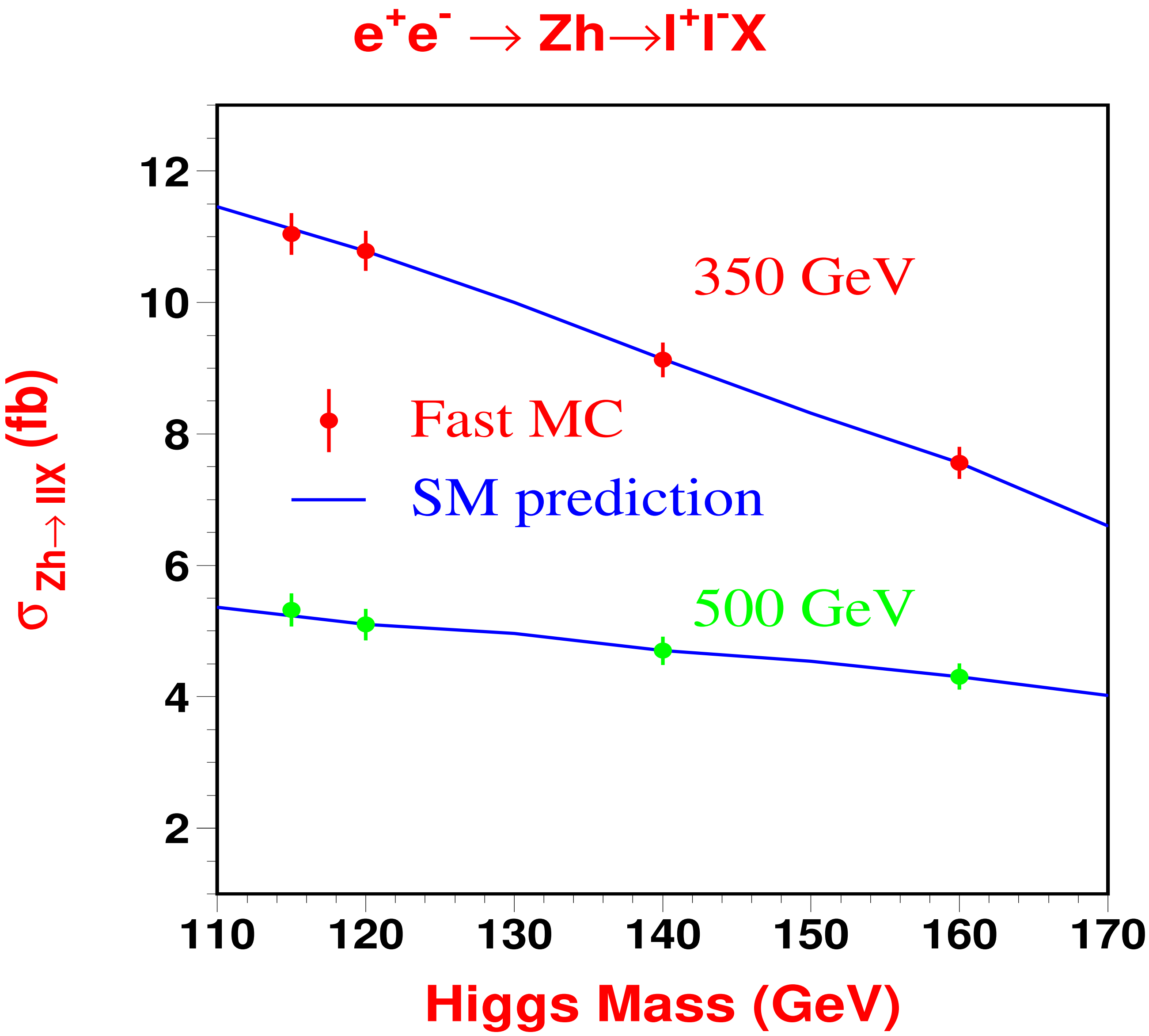


- Monte Carlo Interpolation Method

  $\Longrightarrow \Delta M_{higgs}$ at 350 GeV: $\sim$ 60 MeV.

  $\Longrightarrow \Delta M_{higgs}$ at 500 GeV: $\sim$ 120 MeV.

Cross Section of $ZH \to l^+l^-X(\gamma)$



- Monte Carlo Interpolation Method

  $\Longrightarrow \Delta\sigma/\sigma$ at 350 GeV: $\sim 3\%$.

  $\Longrightarrow \Delta\sigma/\sigma$ at 500 GeV: $\sim 4.7\%$.

Summary

- Fast MC, LDMAR01 & SDMAR01

- $e^+e^- \rightarrow ZH \rightarrow e^+e^-X(\gamma),\ \mu^+\mu^-X(\gamma)$
  $\sqrt{S} = 350,\ 500$ GeV and $\mathcal{L} = 500 fb^{-1}$
  $M_H = 115,\ 120,\ 140,\ 160$ GeV

- Gaussian + Polynominal(P3) fit:
  $\Longrightarrow \Delta M_{higgs}$ at 350 GeV: $\sim$ 100 MeV.
  $\Longrightarrow \Delta M_{higgs}$ at 500 GeV: 300 $\sim$ 400 MeV.
  $\Longrightarrow \sigma_{M_{higgs}}$ at 350 GeV: $\sim$ 1.6 GeV.
  $\Longrightarrow \sigma_{M_{higgs}}$ at 500 GeV: $\sim$ 3.0 GeV.

- MC interpolation method: 2-parameter fit

  - Accuracy of higgs mass:
    $\Longrightarrow \Delta M_{higgs}$ at 350 GeV: $\sim$ 60 MeV.
    $\Longrightarrow \Delta M_{higgs}$ at 500 GeV: $\sim$ 120 MeV.

  - Cross section of $ZH \rightarrow e^+e^-X(\gamma),\ \mu^+\mu^-X(\gamma)$:
    $\Longrightarrow \Delta\sigma/\sigma$ at 350 GeV: $\sim$ 3%.
    $\Longrightarrow \Delta\sigma/\sigma$ at 500 GeV: $\sim$ 4.7%.