

Measuring the Higgs Cross Section and Mass with TESLA

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7 th ECFA/DESY workshop

Hamburg, September 22 – 25, 2000

- * We want to determine $\sigma(\text{ZH})$ bias free:

independent of $\text{BR}(\text{H} \rightarrow \text{X})$

- * We use $e^+e^- \rightarrow \text{ZH} \rightarrow \ell^+\ell^-X$ processes,
where $\ell = e, \mu$:

clean signature, independent of X

- * M_{H} and $\sigma(\text{ZH})$ are determined from the
recoiling against the e^+e^- and $\mu^+\mu^-$ pairs

- * ℓ^\pm identification and background estimate
in *realistic conditions*

- * Study done at $\sqrt{s} = 350 \text{ GeV}$ and $\mathcal{L} = 500 \text{ fb}^{-1}$:

$M_{\text{H}} = 120, 150 \text{ and } 180 \text{ GeV}$

- **Signal:** $e^+e^- \rightarrow ZH \rightarrow \ell^+\ell^-X (\gamma)$

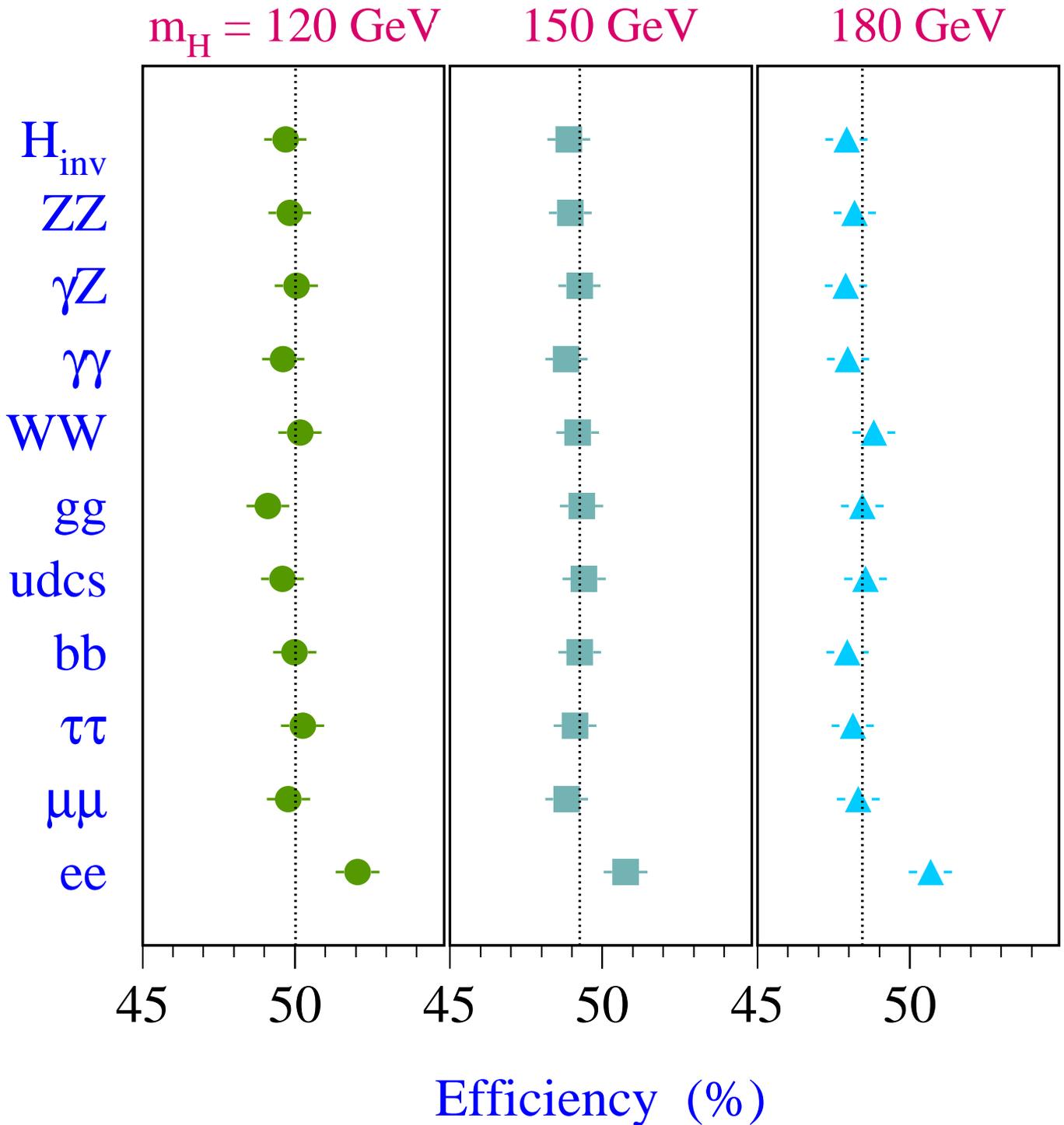
M_H (GeV)	σ (fb)	# of events
120	5.3	2.6×10^3
150	3.8	1.9×10^3
180	2.8	1.4×10^3

- **Expected background for $\mathcal{L} = 500 \text{ fb}^{-1}$:**

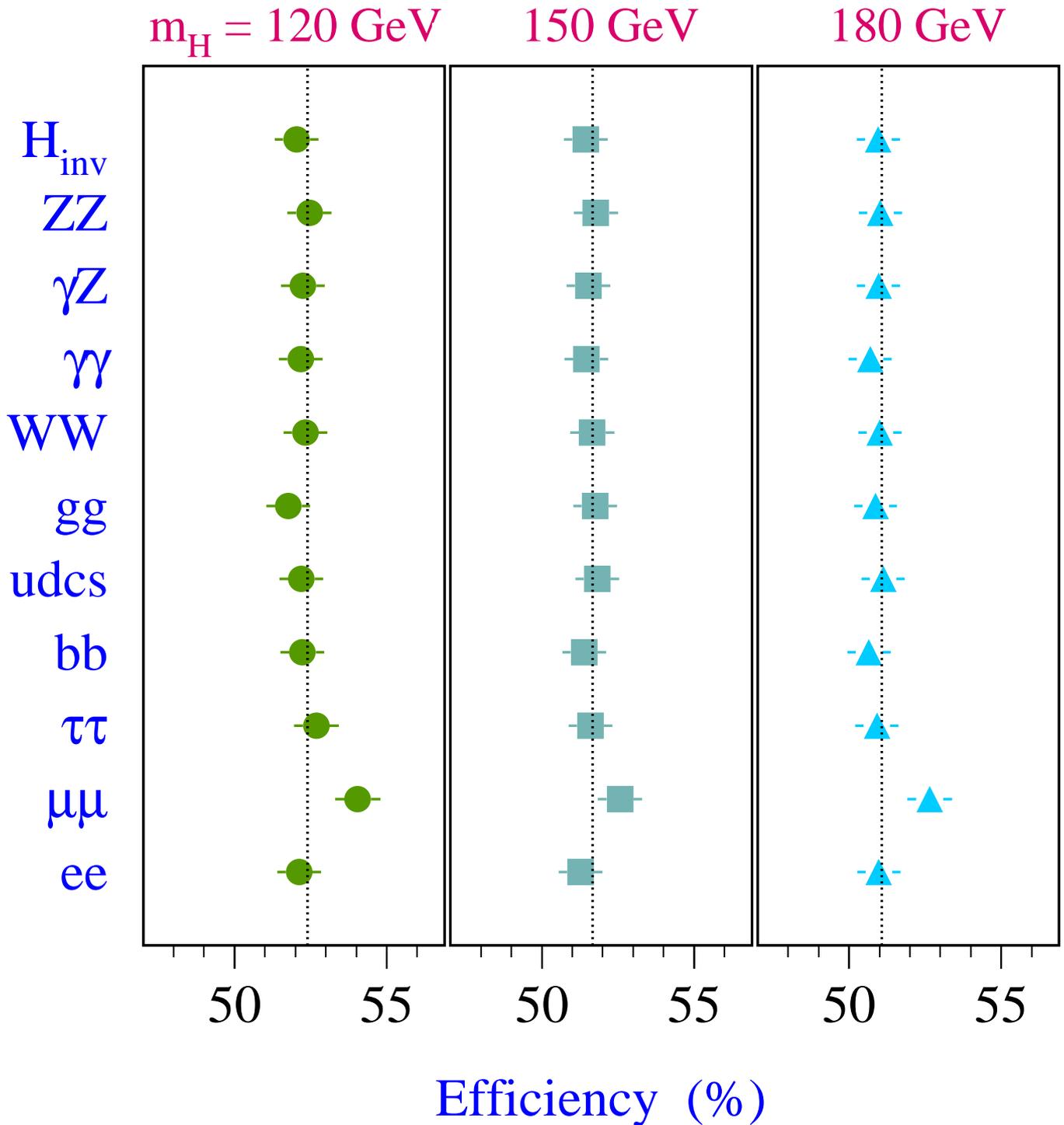
Background	σ (fb)	# of events
$\gamma\gamma \rightarrow f\bar{f}$	4.3×10^6	2×10^9
$e^+e^- \rightarrow \gamma, Z$	4.0×10^4	2×10^7
$e^+e^- \rightarrow W^+W^-$	1.3×10^4	7×10^6
$e^+e^- \rightarrow ZZ$	1.0×10^3	5×10^5

- * μ identified as MIPs in ECAL and HCAL with an associated track:
- * e identified as a cluster in ECAL with an associated track:
- * We require at least two leptons with $P_\ell > 10$ GeV and:
 - $|\cos \theta_{\ell\ell}| < 0.6$
 - $M_{\ell\ell} = M_Z \pm 5$ GeV
- Overall selection efficiency for electrons and muons: $\approx 50\%$

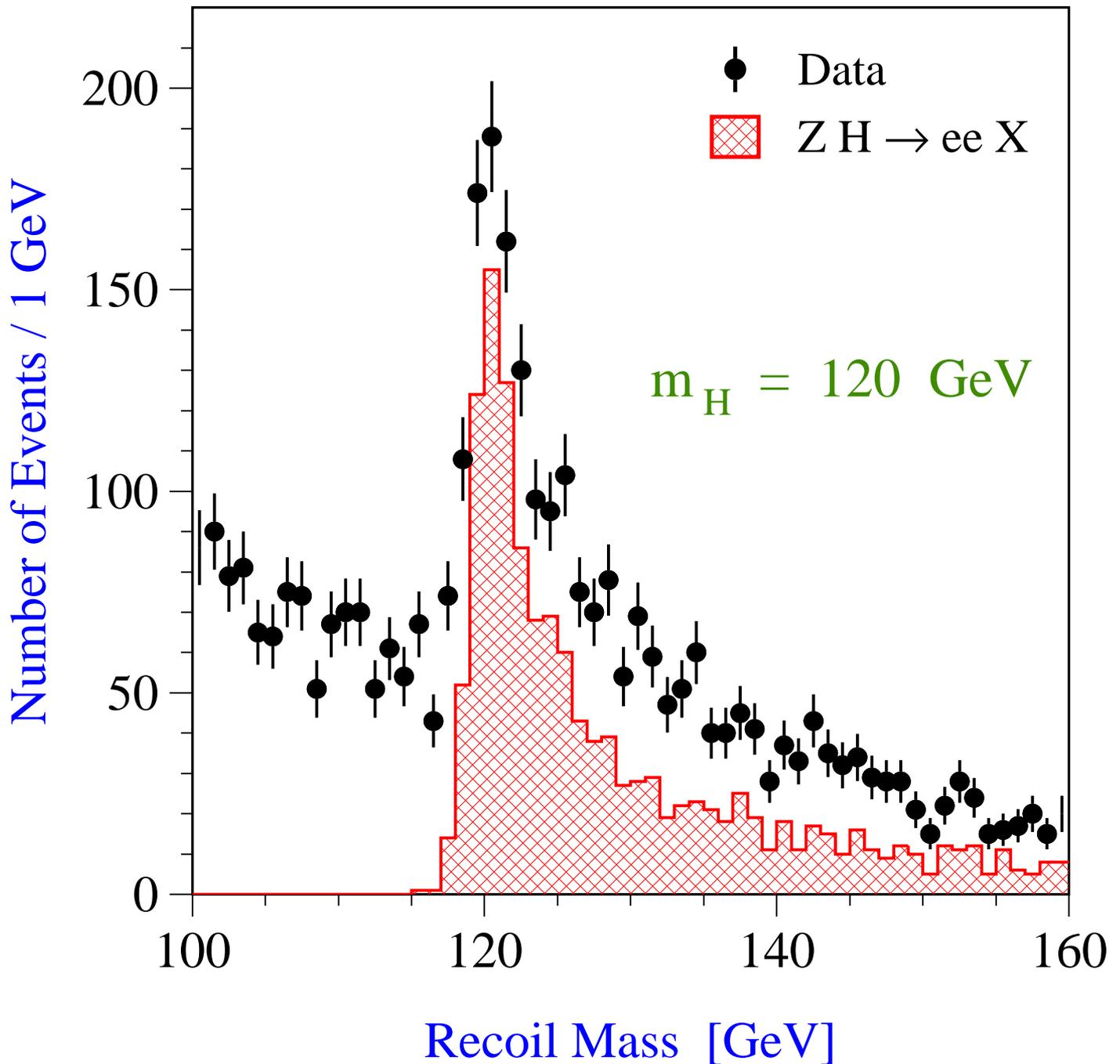
The efficiency is (almost) independent of the Higgs decay mode



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The recoil mass spectrum from e^+e^-

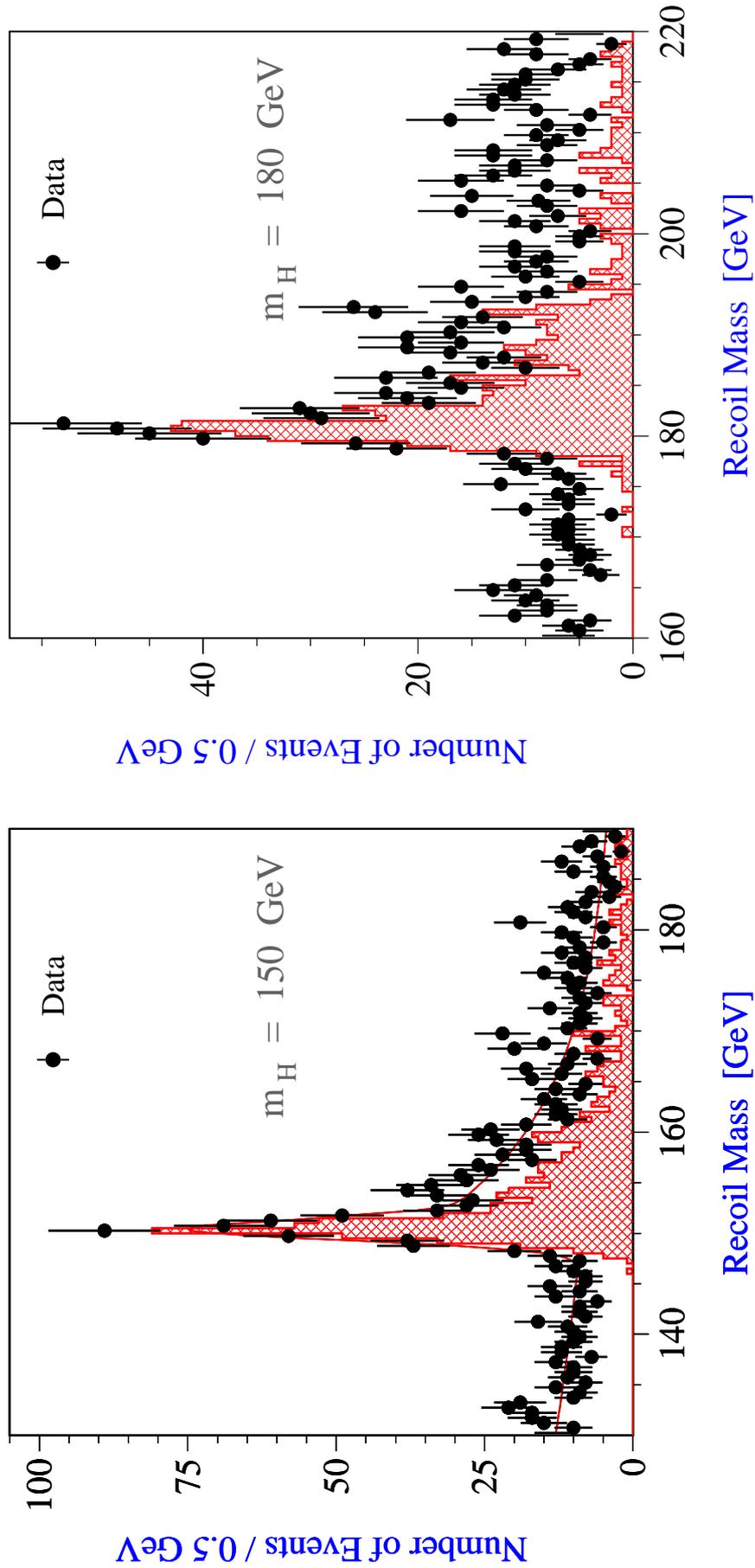


$$\Delta\sigma/\sigma \approx 4\%$$

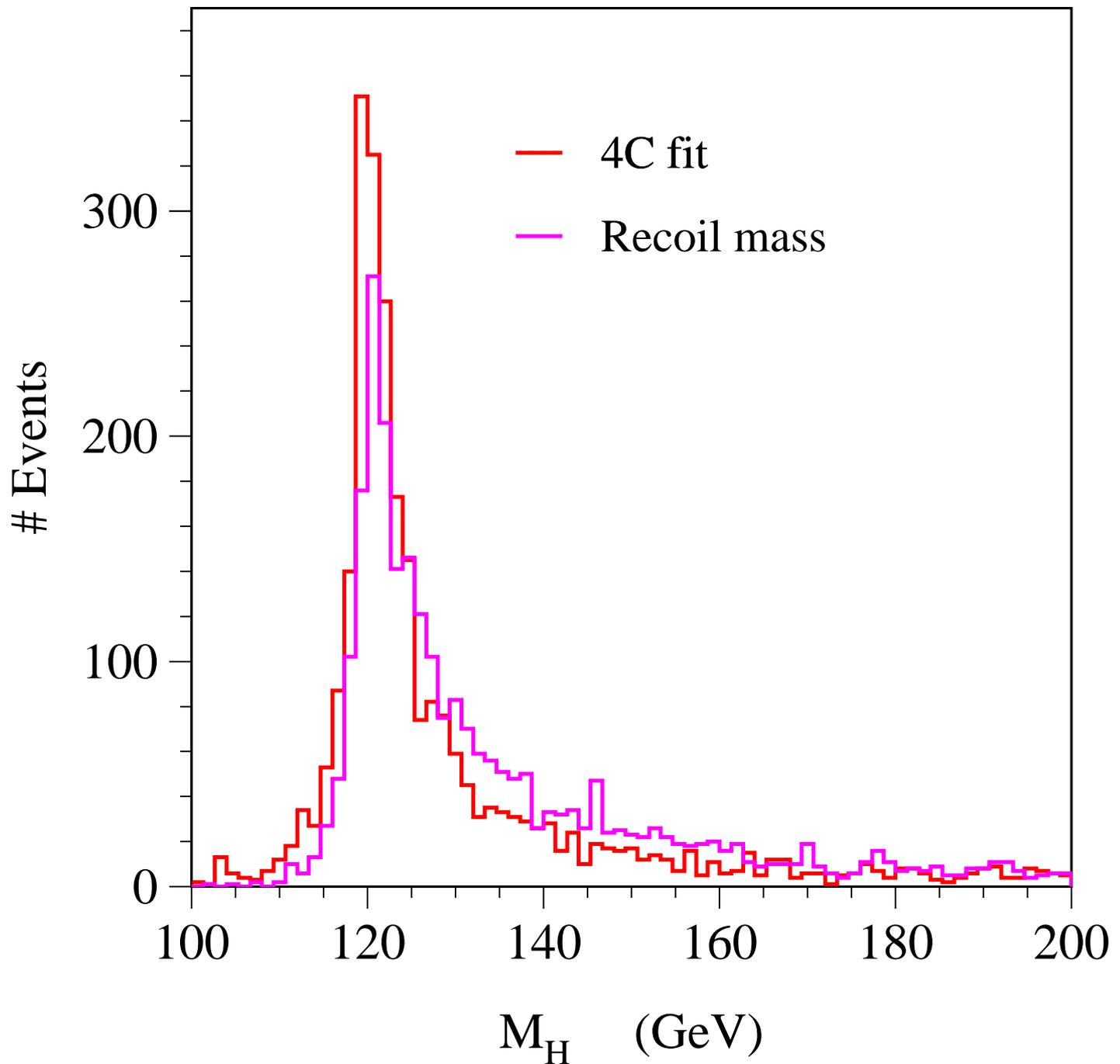
$$\Delta M_H \approx 150 \text{ MeV}$$

Recoil Mass

The recoil mass for e^+e^-



mass spectrum after 4C kinematic fit



$$\Delta M_H \approx 80 \text{ MeV}$$

- Clean selection of $ZH \rightarrow e^+e^-X$
and $ZH \rightarrow \mu^+\mu^-X$,
independent of the Higgs decay mode
- $e^+e^- \rightarrow ZH$ cross section from

$$\Delta\sigma/\sigma \approx 3\% (M_H = 120 \text{ GeV})$$

to

$$\Delta\sigma/\sigma \approx 4\% (M_H = 180 \text{ GeV})$$

e^+e^- and $\mu^+\mu^-$ combined

- Higgs mass peak: $\Delta M_H \simeq 150 \text{ MeV}$

Summary of mass measurements from different channels and techniques:

	$\ell\ell b\bar{b}$ 4C	$q\bar{q}b\bar{b}(q\bar{q})$	combined
$\Delta M_H(M_H = 120 \text{ GeV})$	80 MeV	50 MeV	40 MeV
$\Delta M_H(M_H = 180 \text{ GeV})$	110 ¹ MeV	150 MeV	90 MeV