The Higgs Boson Width Through WW-Fusion at TESLA –Update–

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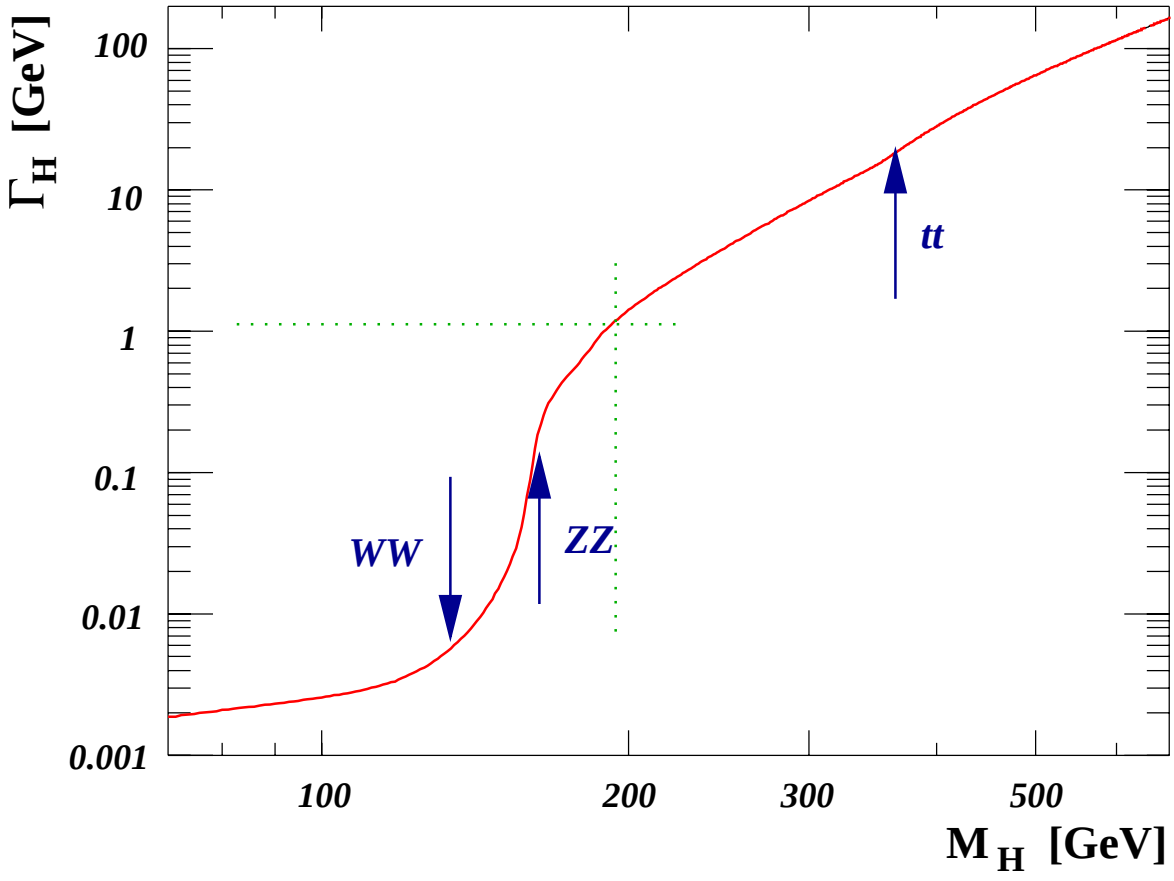
- **Introduction**
- **How to determine Γ_H^{tot}**
- **Selection for $\sigma(WW-\mathrm{fusion})$**
- **Results**

Introduction



Width of SM Higgs boson

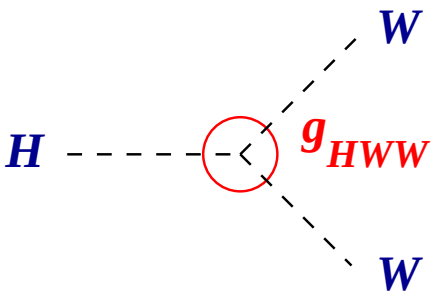
Below $\Gamma_H^{tot} = 1\ \mathrm{GeV}\ /\ m_H \approx 200\ \mathrm{GeV}$

indirect method needed

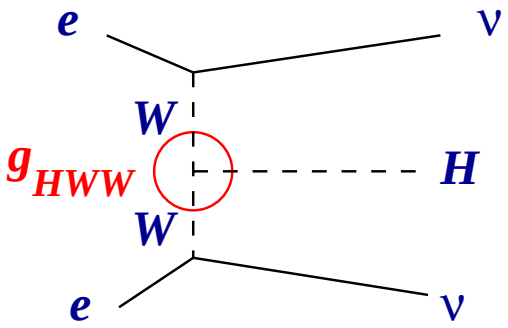
- **Which method ?**
- **Which accuracy ?**

Method

$$\Gamma_H^{tot} = \frac{\Gamma(H \to WW)}{\mathrm{BR}(H \to WW)}$$



Decay $H \longrightarrow WW$



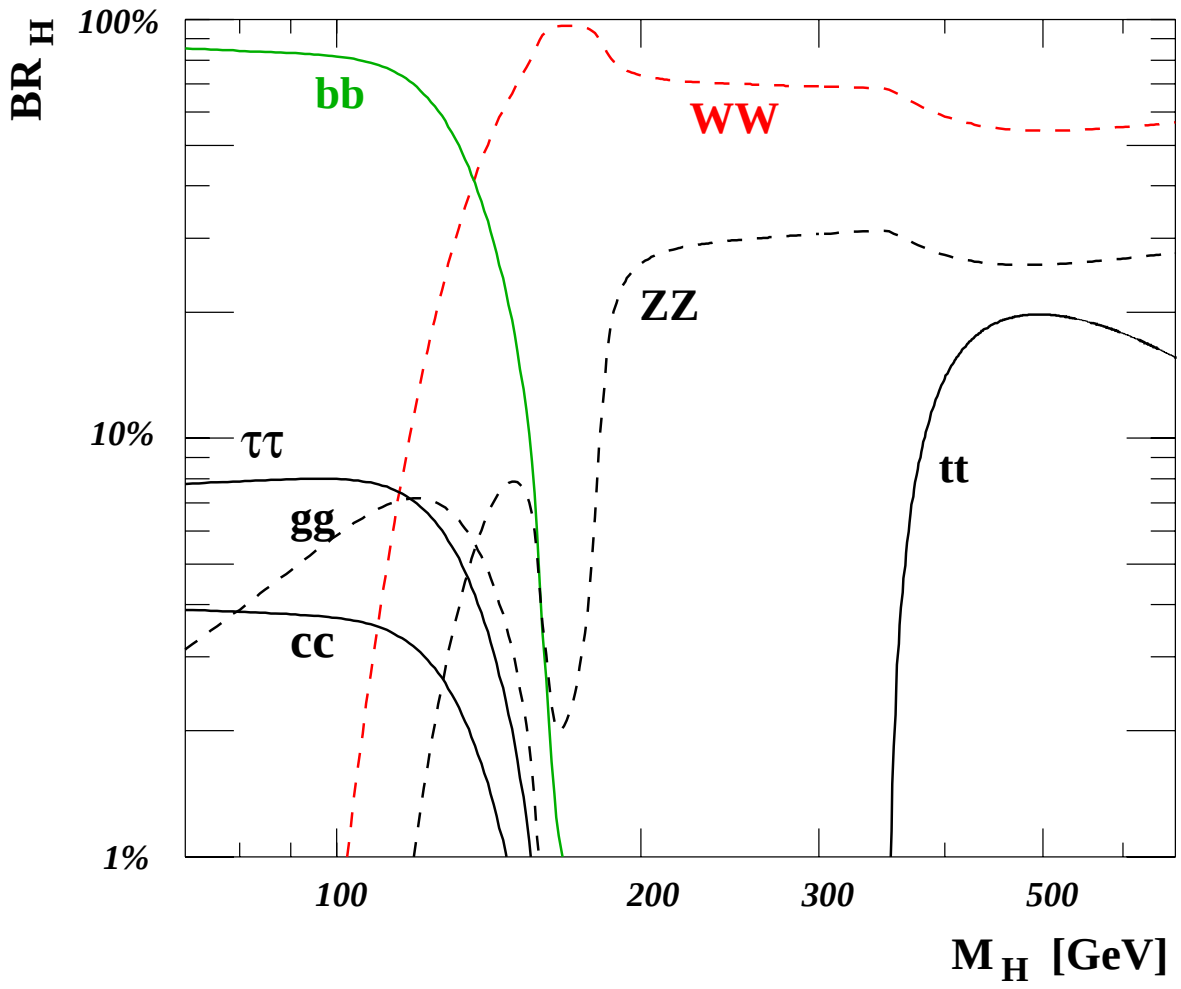
WW-Fusion

Everything known except g_{HWW}

$$\Gamma(H \to WW) \propto g^2_{HWW} \propto \sigma(WW-\mathrm{fusion})$$

$$\Gamma_H^{tot} \propto \frac{\sigma(WW-\mathrm{fusion})}{\mathrm{BR}(h \to WW)}$$

Determining $\sigma(WW-\text{fusion})$



Low mass range $m_H = 120..150\ \text{GeV}$:

$H \to b\bar{b}$ **dominant**

$$\sigma(WW-\text{fusion}) = \frac{\sigma_{fus}(H \to b\bar{b})}{\text{BR}(H \to b\bar{b})}$$

Technicalities

$$\sqrt{s} = 350, 500 \text{ GeV}$$

$$\mathcal{L} = 500 \text{ fb}^{-1}$$

Complete $bb\nu\nu$ final state taken into account

(WHiZard by W. Kilian)

Dominant 4 fermion processes (2+ quarks) generated

by PYTHIA 6.1

Higgs-BR as in HDECAY (by M. Spira)

Parameterized b-tag including jet-energy dependence

by R. Hawkings

WHiZard by W. Kilian

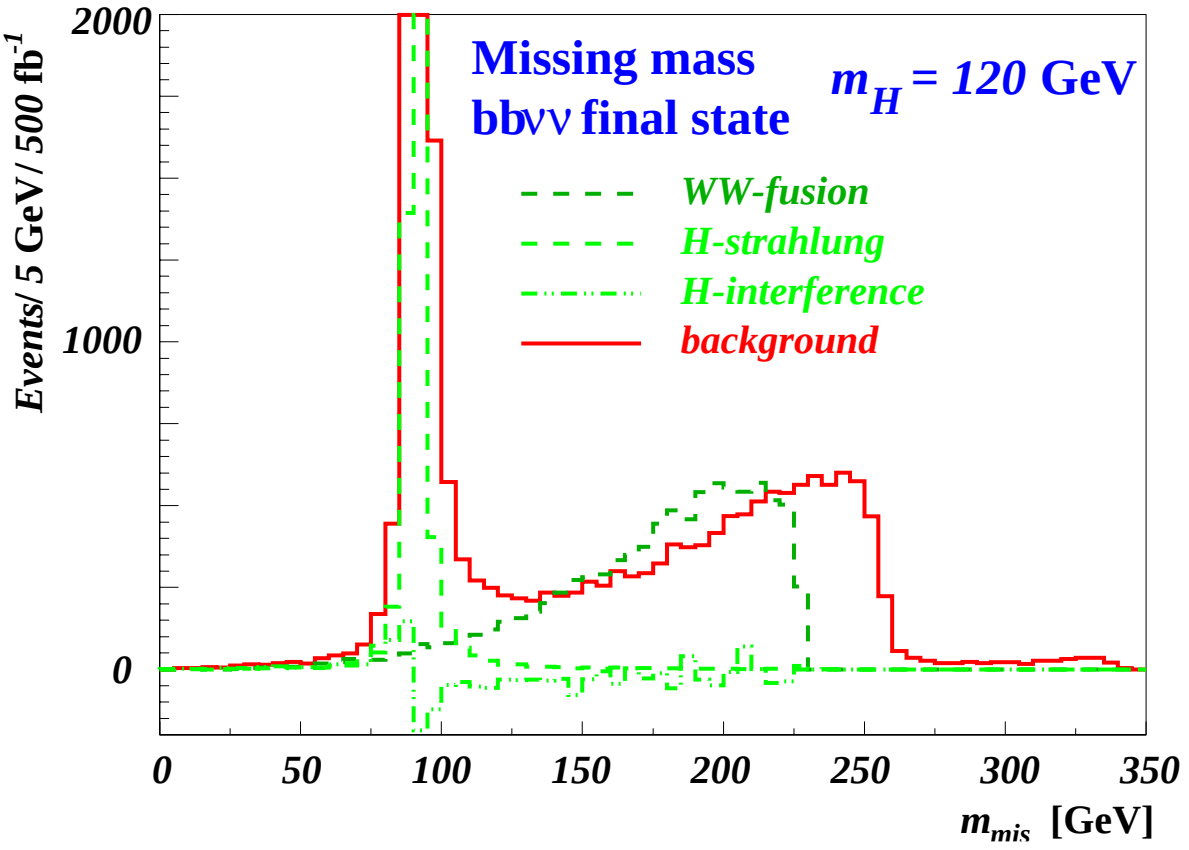
W, Higgs, Z and respective decays

By Wolfgang Kilian, University of Karlsruhe

Integrates matrix elements from CompHEP or MADGRAPH

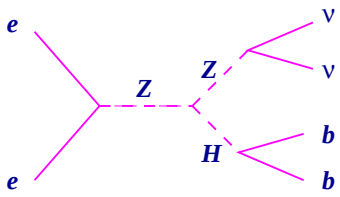
Includes inteference, ISR and QCD-corrections

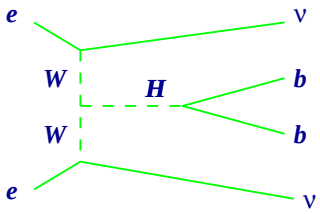
Returns fermion-four-vectors



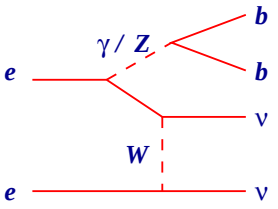
Processes WHiZard

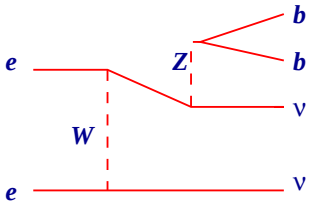
Higgs

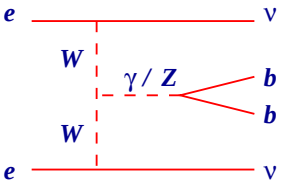


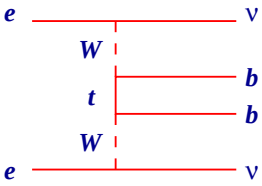


$\nu = \nu_e$

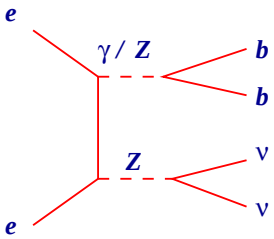


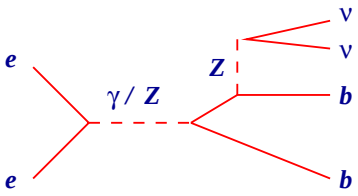


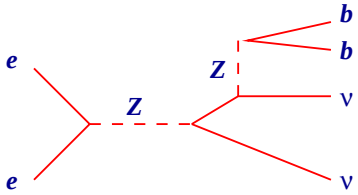




$\nu = \nu_x$







Background PYTHIA

$$WW \to qql\nu \qquad q = u, d, s, c, b$$
$$WW \to qqqq \qquad q = u, d, s, c, b$$

$$We\nu \to qqe\nu \qquad q = u, d, s, c, b$$

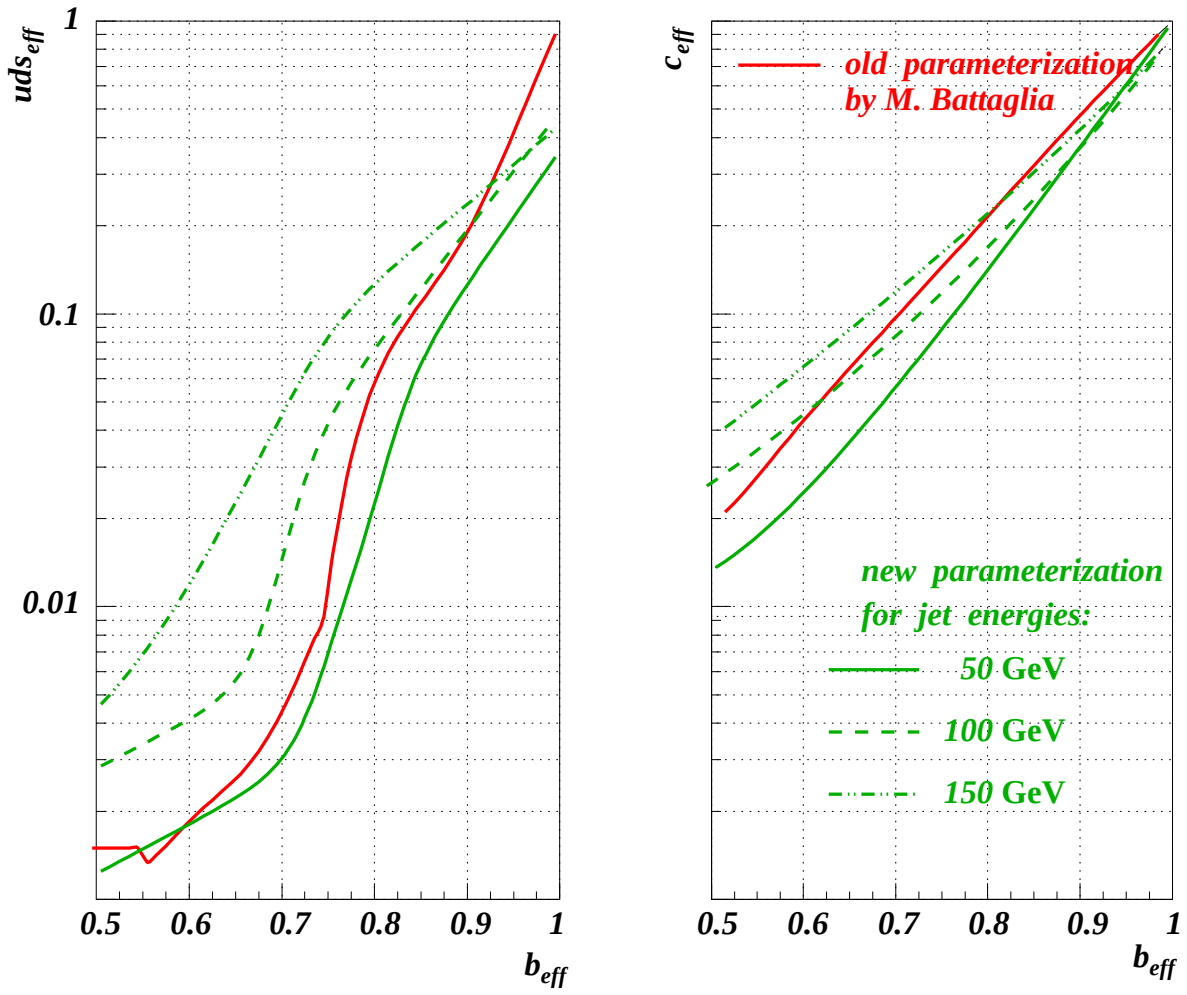
$$ZZ \to qq\nu\nu \qquad q = u, d, s, c$$
$$ZZ \to qqqq \qquad q = u, d, s, c, b$$
$$ZZ \to qql^+l^- \qquad q = u, d, s, c, b$$

$$Zee \to qqee \qquad q = u, d, s, c, b$$

$$e^+e^- \to qq \qquad q = u, d, s, c, b, t$$

New b-tag Parameterization

By Richard Hawkings, CERN



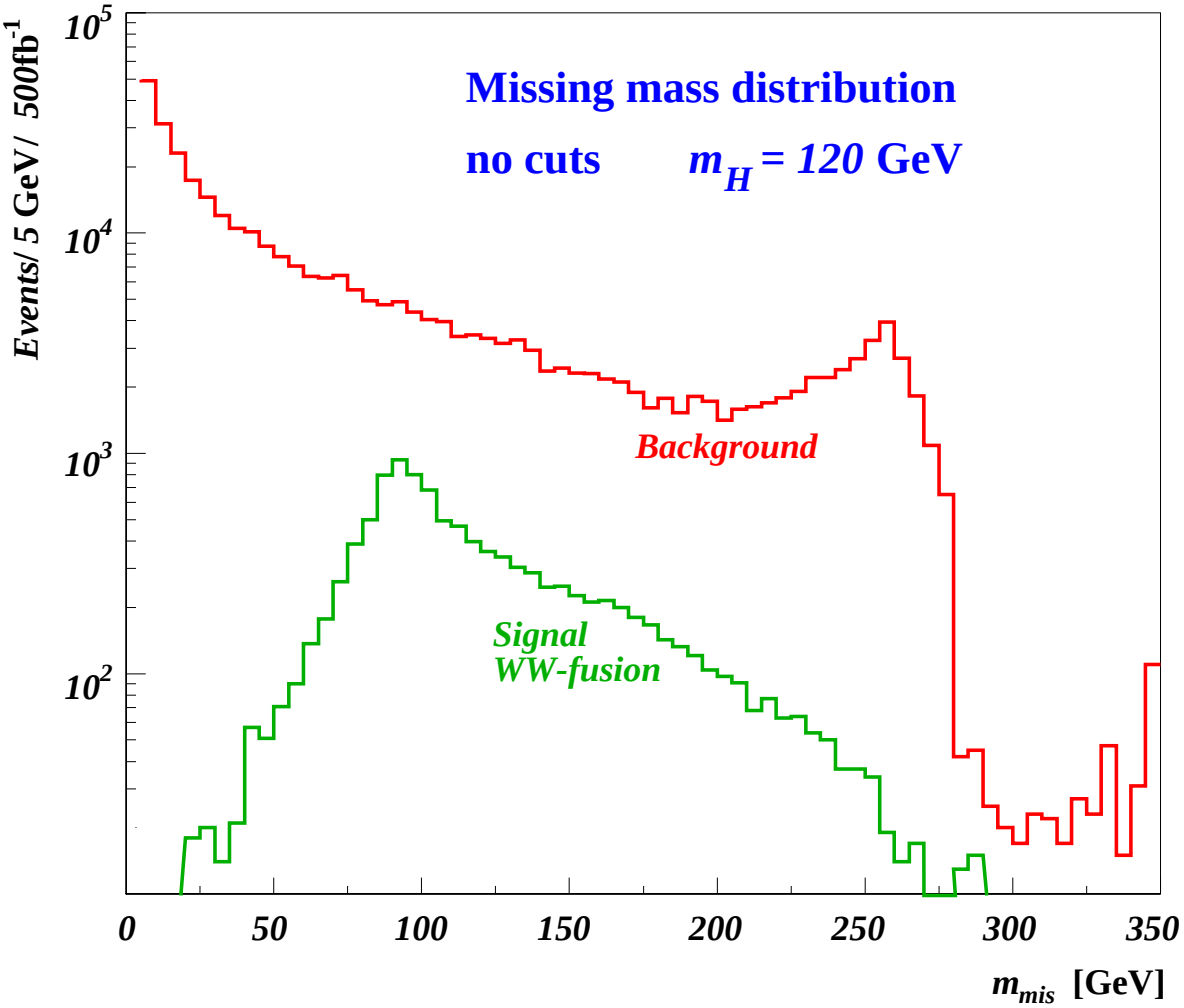
Parameterizes efficiencies as

function of jet-energies

and b-tag effi

Selection

Cut based missing mass selection



	$N(\text{bgrd})$	$N(WW-\text{fusion})$
no cuts	3.7×10^5	11350
cuts	757	2940

$\sim$ 26 % efficiency

χ^2 Fit

χ^2-Fit on missing mass distribution

Normalized MC as reference

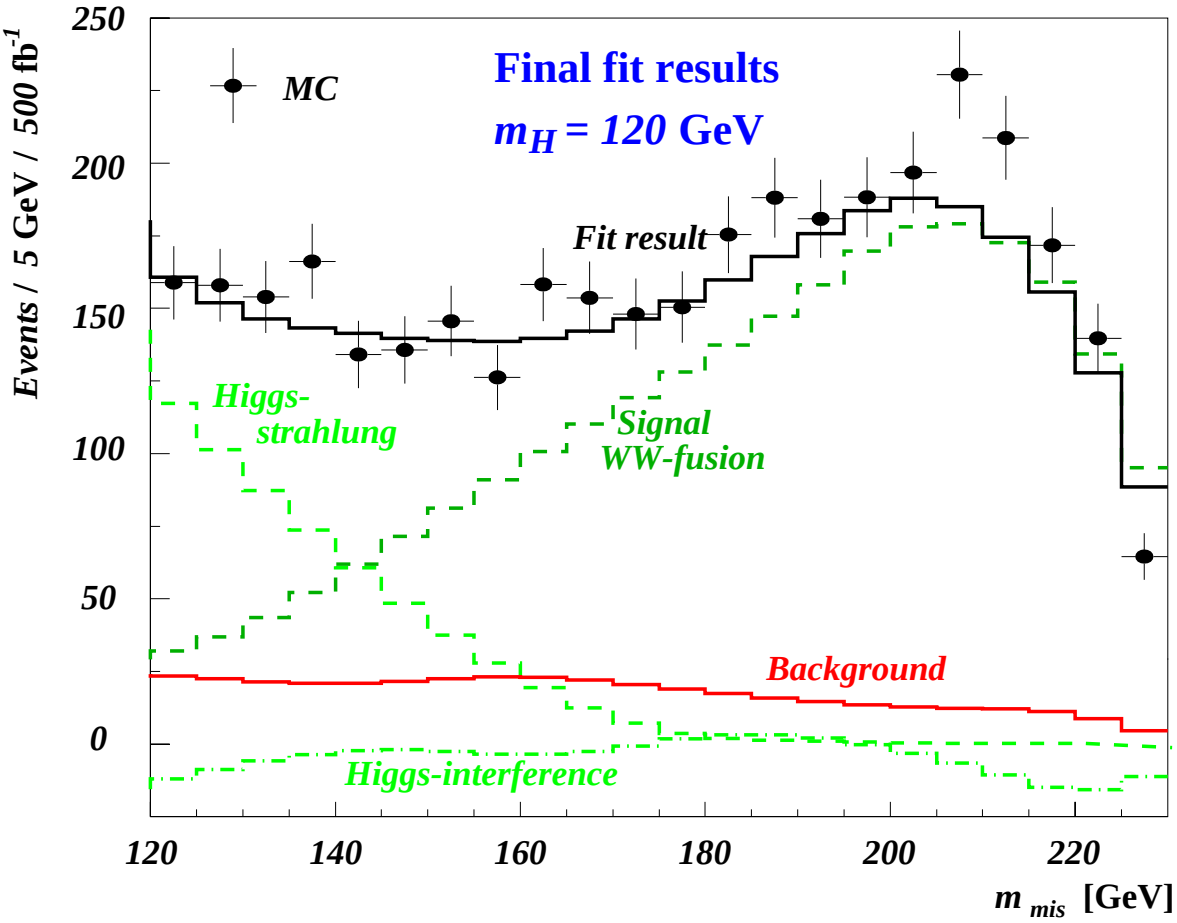
Fit-parameters :

$$N(WW-\text{fusion}),\ N(\text{bkgrd})$$

Fixed :

$N(H-\text{strahlung})$ **(known)**

$N(\text{interf.})$ **(small)**



Results

m_H	ΔBR $(H \to b\bar{b})$	ΔBR $(H \to WW)$	$\Delta\sigma_{fus}$ 350 / 500 GeV	$\Delta\Gamma_H^{tot}$ 350 / 500 GeV
120	2,5 %	5,4 %	2,6 / 1,9 %	6,5 / 6,2 %
130	2,8 %	3,3* %	3,5 / 2,2 %	5,5 / 4,9 %
140	3,1 %	2,5 %	4,9 / 3,2 %	6,3 / 5,1 %
150	7* %	3,1* %	8,4 / 5,2 %	11,1 / 9 %
160	12 %	3,1 %	imp. / 12,1 %	imp. / 17,4 %

*) extrapolated

Conclusions

$5 - 6\ \%$ accuracy on Γ_H^{tot} with
$\mathcal{L} = 500\ \mathrm{fb}^{-1}$ and $m_H \leq 150\ \mathrm{GeV}$

$\Rightarrow$ Method superior to $\gamma\gamma$-option

(Similar method at compton collider)

$\Delta\Gamma_H^{tot} \sim 14\ \%$ with equivalent lumi

For $\mathrm{m_H} > 160\ \mathrm{GeV}$ selection of $H \to WW$ necessary

Overlaid $\gamma\gamma$-events can be handled

(cf. talk of M. Battaglia)

Write-up in progress