Higgs search at LHC

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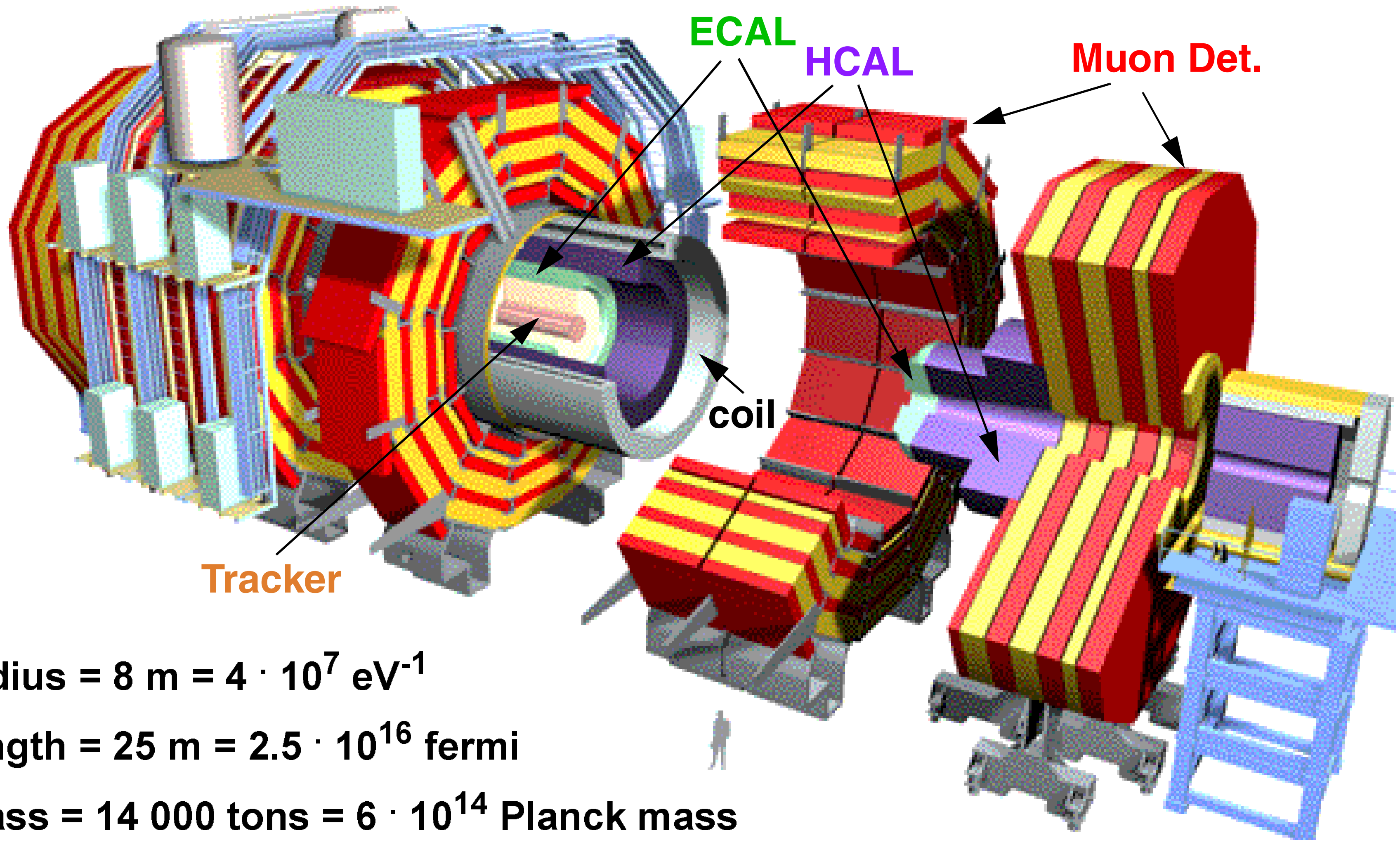
Area map of
CERN site
Jura Mountains
LAC LEMAN
N
LHC
CMS
ATLAS
Paris
SWITZERLAND
FRANCE
Nyon
Divonne
Gex
ALEPH
OPAL
Versoix
Ferney Voltaire
St.Genis
L3
DELPHI
CERN
Meyrin
Airport
GENEVA
Annemasse
St. Julien
Lyon
0
5
km
SWITZERLAND
FRANCE
Legend:
CERN sites
accelerator
LEP experiment
motorway
road
city
border
Annecy
(LAPP)
Chamonix
(Mont Blanc)

Compact Muon Solenoid — CMS



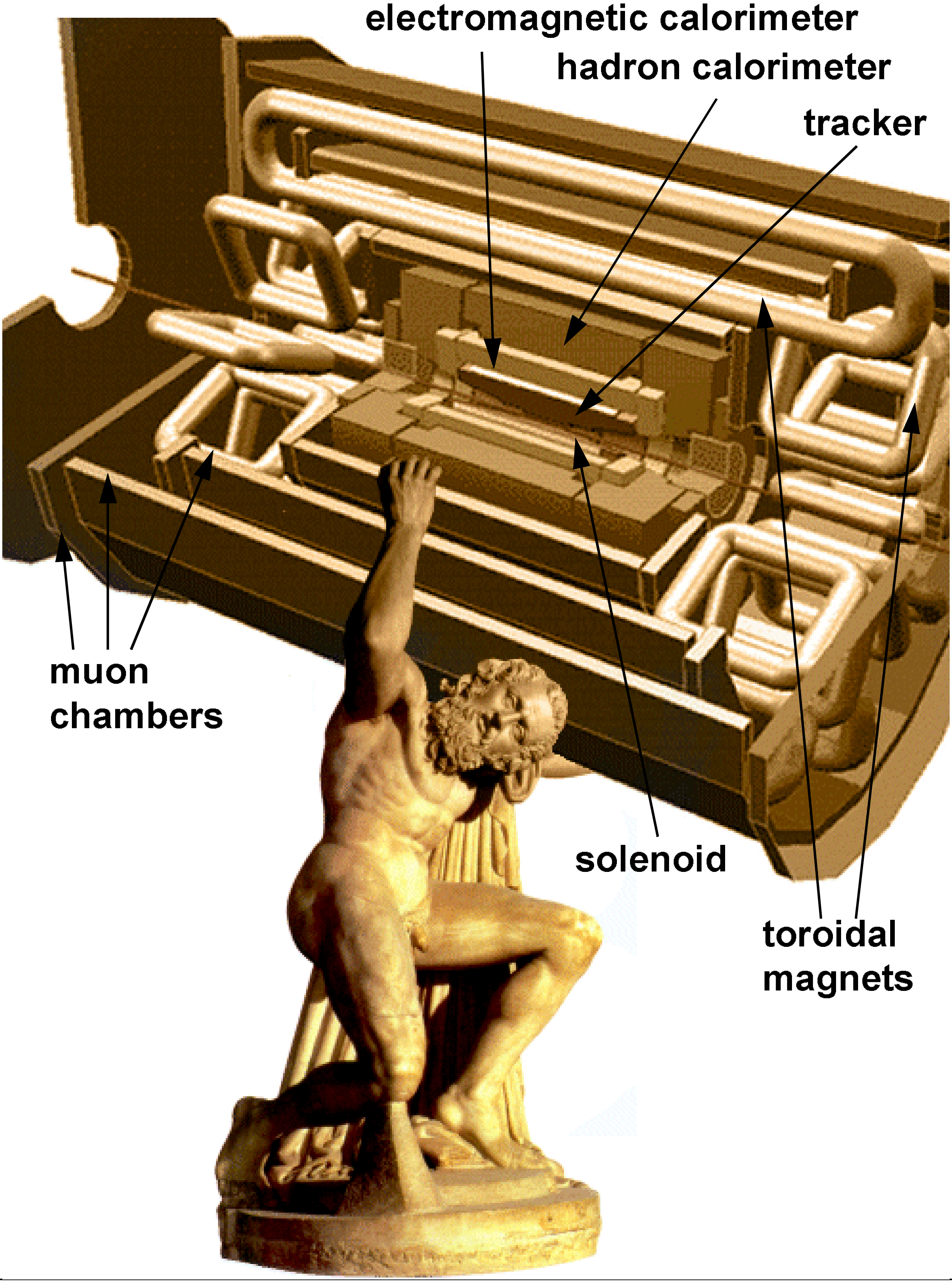
radius = 8 m = $4 \cdot 10^{7}$ eV^{-1}

length = 25 m = $2.5 \cdot 10^{16}$ fermi

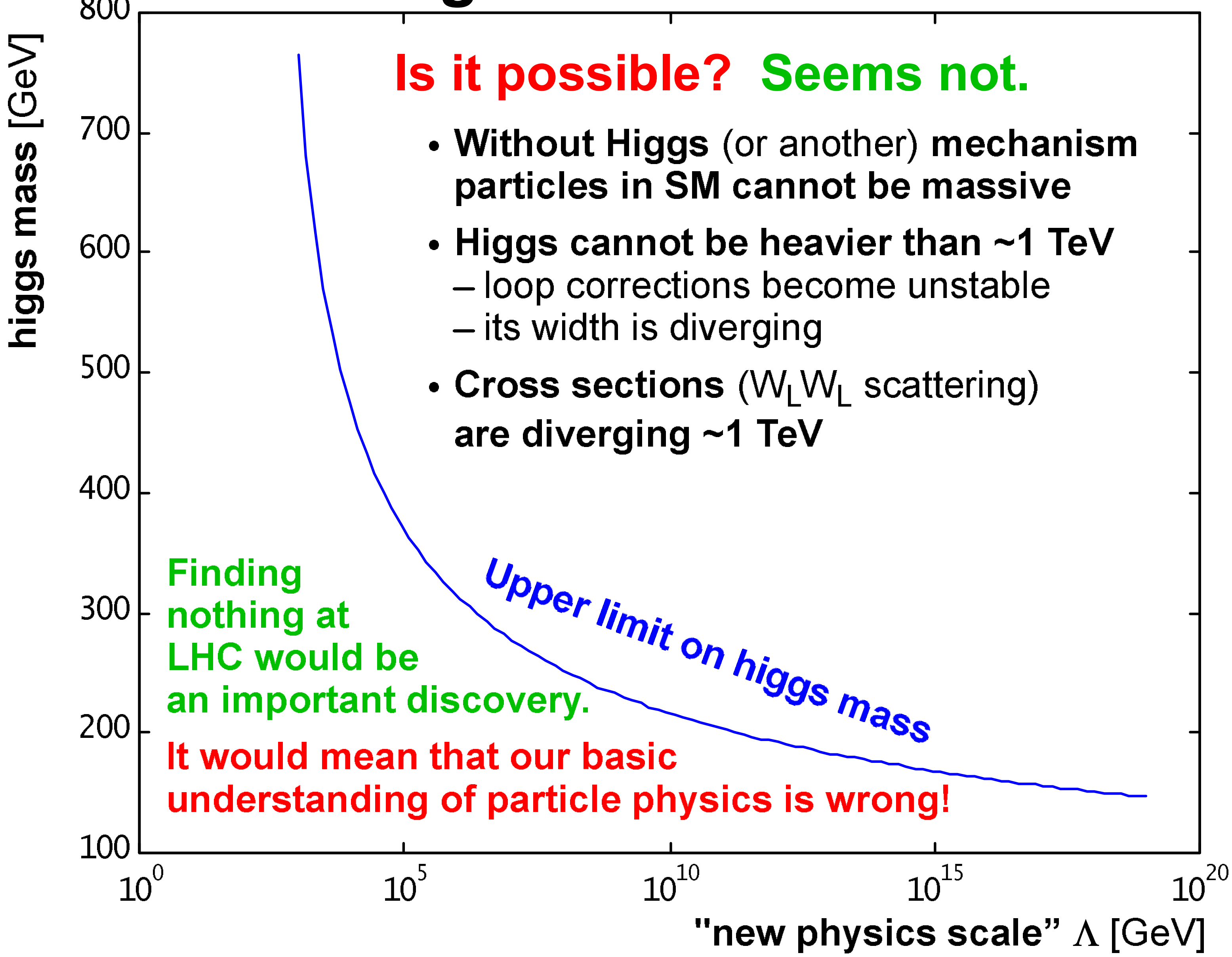
mass = 14 000 tons = $6 \cdot 10^{14}$ Planck mass

mag. field = 4 T

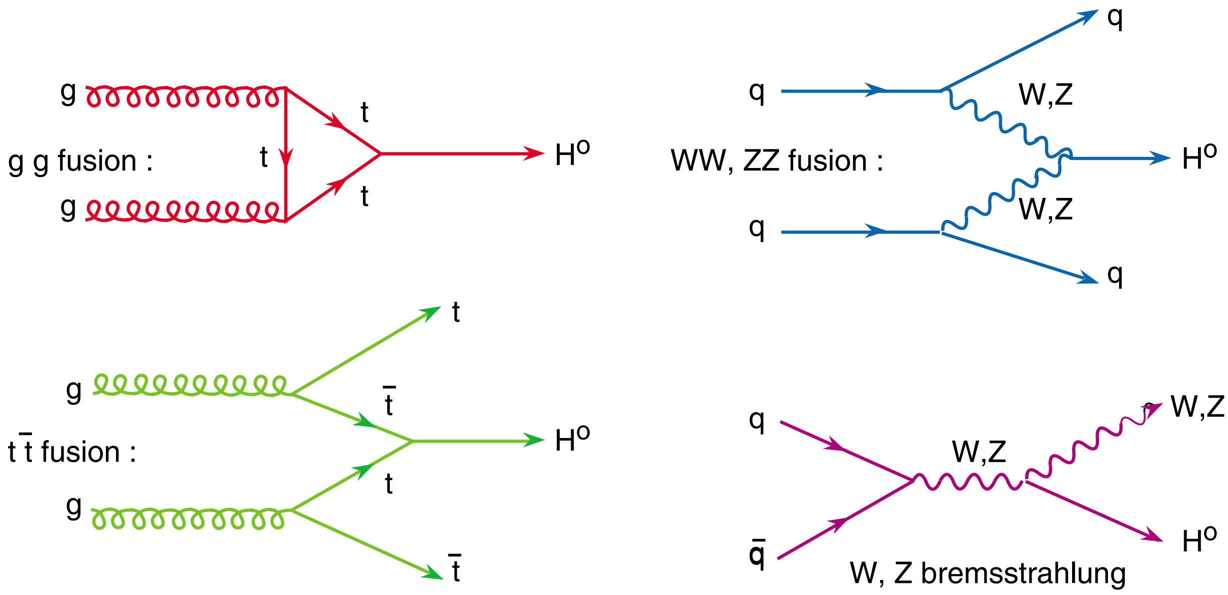
ATLAS

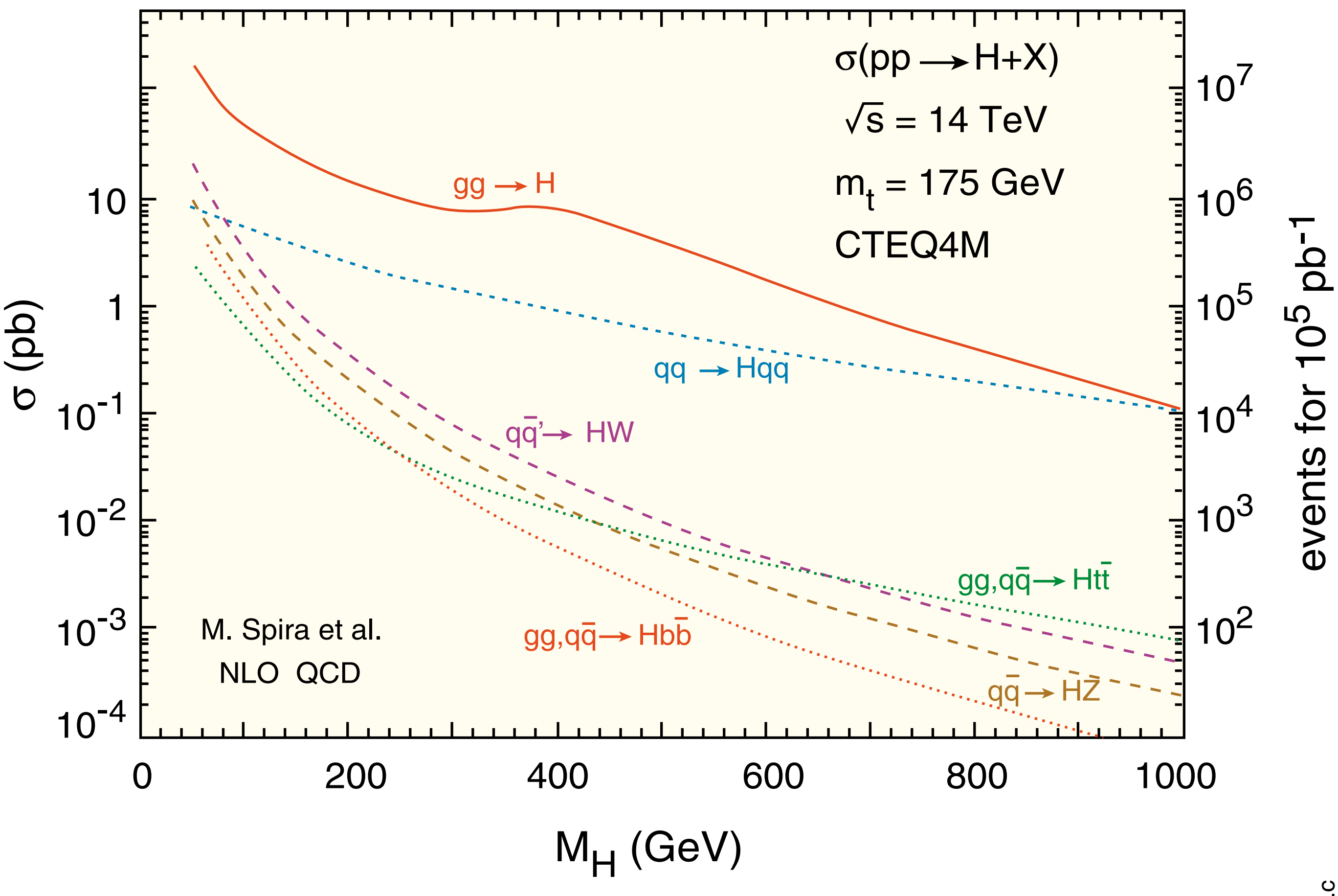

electromagnetic calorimeter
hadron calorimeter
tracker
muon
chambers
solenoid
toroidal
magnets

Nothing discovered at LHC ?



H^o production at hadron colliders:

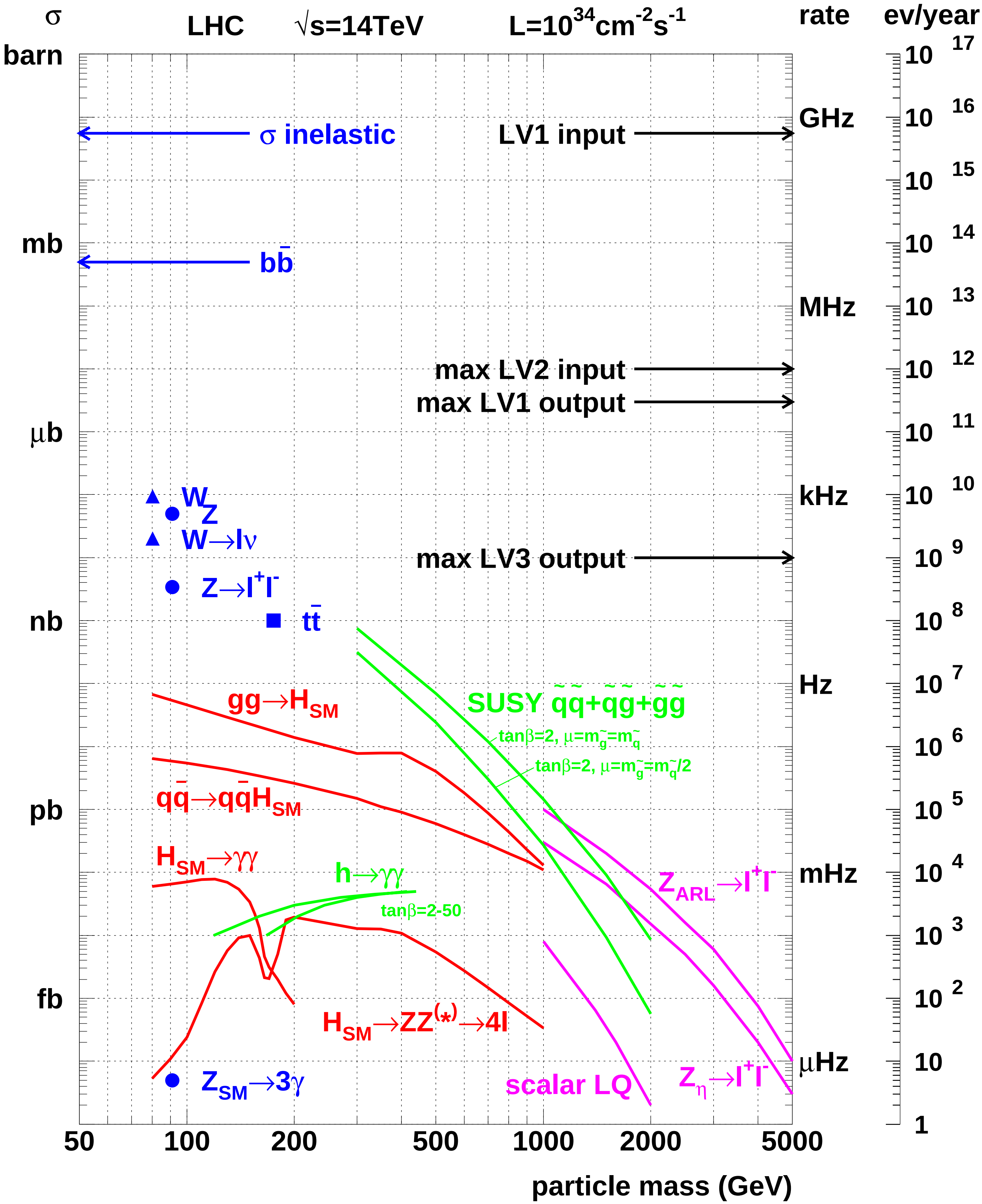


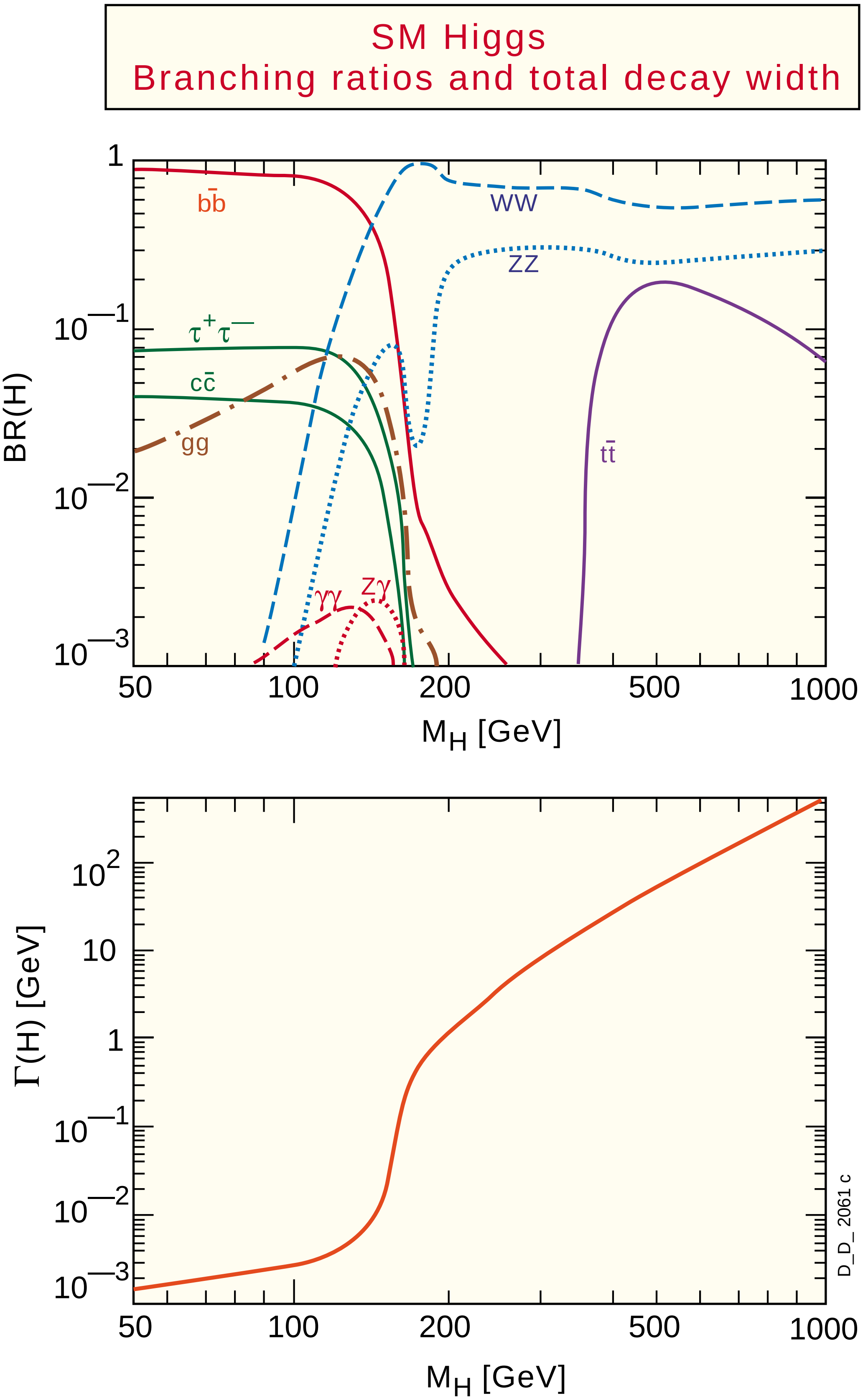


But : BR (H → Z¡Z¡ → 4l⁻) = 1.4 ¥ 10^{-3}

BR (H → Z¡Z¡ → 4∝⁻) = 3 ¥ 10^{-4}

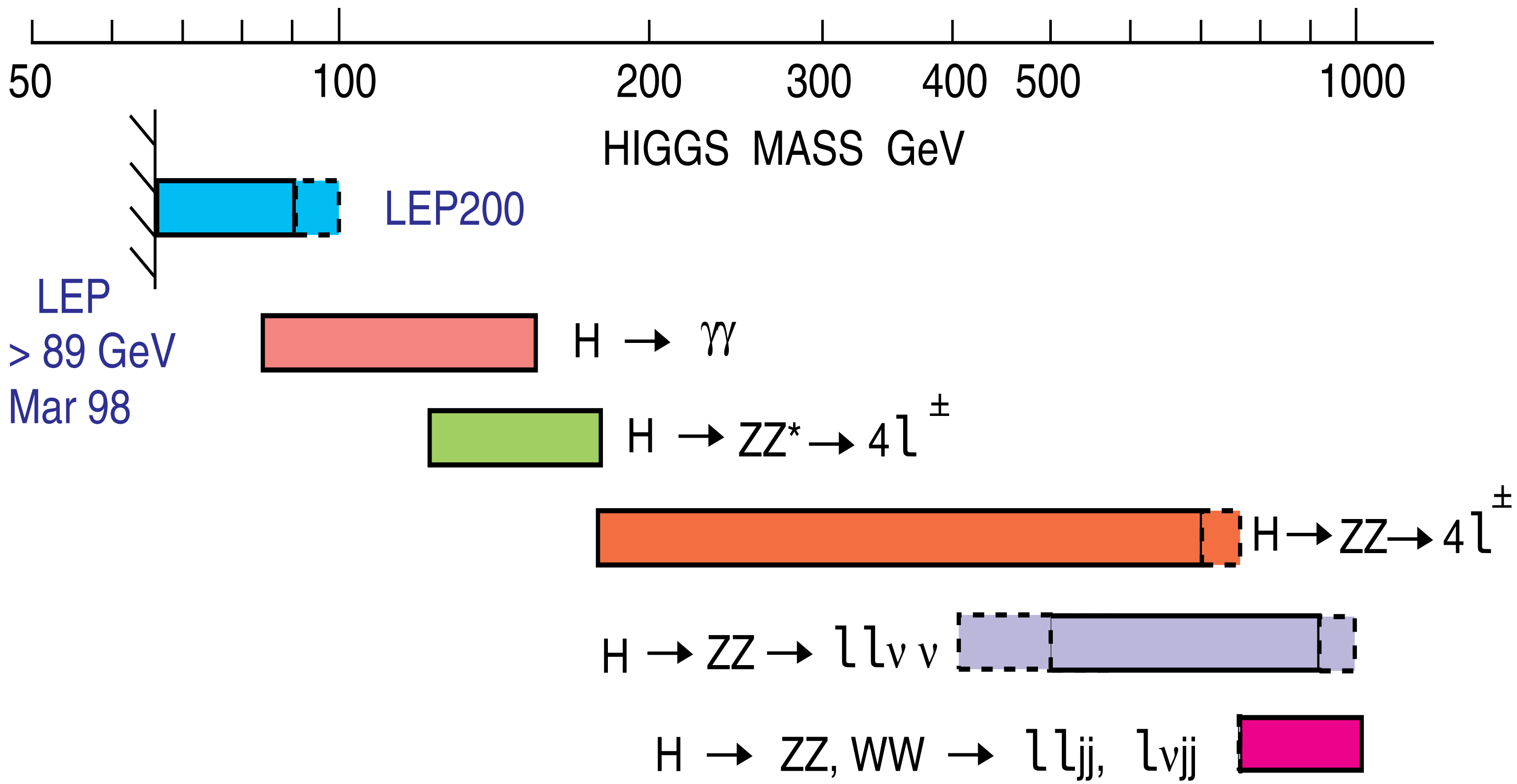
D_D_1186.c


σ
barn
mb
μb
nb
pb
fb
LHC
√s=14TeV
L=10^34 cm^-2 s^-1
rate
ev/year
GHz
MHz
kHz
Hz
mHz
μHz
10 17
10 16
10 15
10 14
10 13
10 12
10 11
10 10
10 9
10 8
10 7
10 6
10 5
10 4
10 3
10 2
10
1
σ inelastic
LV1 input
bb̄
max LV2 input
max LV1 output
max LV3 output
W
Z
W→lν
Z→l+l-
tt̄
gg→H_SM
qq̄→qq̄H_SM
H_SM→γγ
h→γγ
tanβ=2-50
SUSY q̃q̃+q̃g̃+g̃g̃
tanβ=2, μ=m_g̃=m_q̃
tanβ=2, μ=m_g̃=m_q̃/2
Z_ARL→l+l-
H_SM→ZZ(*)→4l
scalar LQ
Z_η→l+l-
Z_SM→3γ
50
100
200
500
1000
2000
5000
particle mass (GeV)


SM Higgs
Branching ratios and total decay width
BR(H)
bb̄
WW
ZZ
τ+τ−
cc̄
gg
tt̄
γγ
Zγ
1
10−1
10−2
10−3
50
100
200
500
1000
MH [GeV]
Γ(H) [GeV]
10²
10
1
10−1
10−2
10−3
50
100
200
500
1000
MH [GeV]
D_D_2061 c

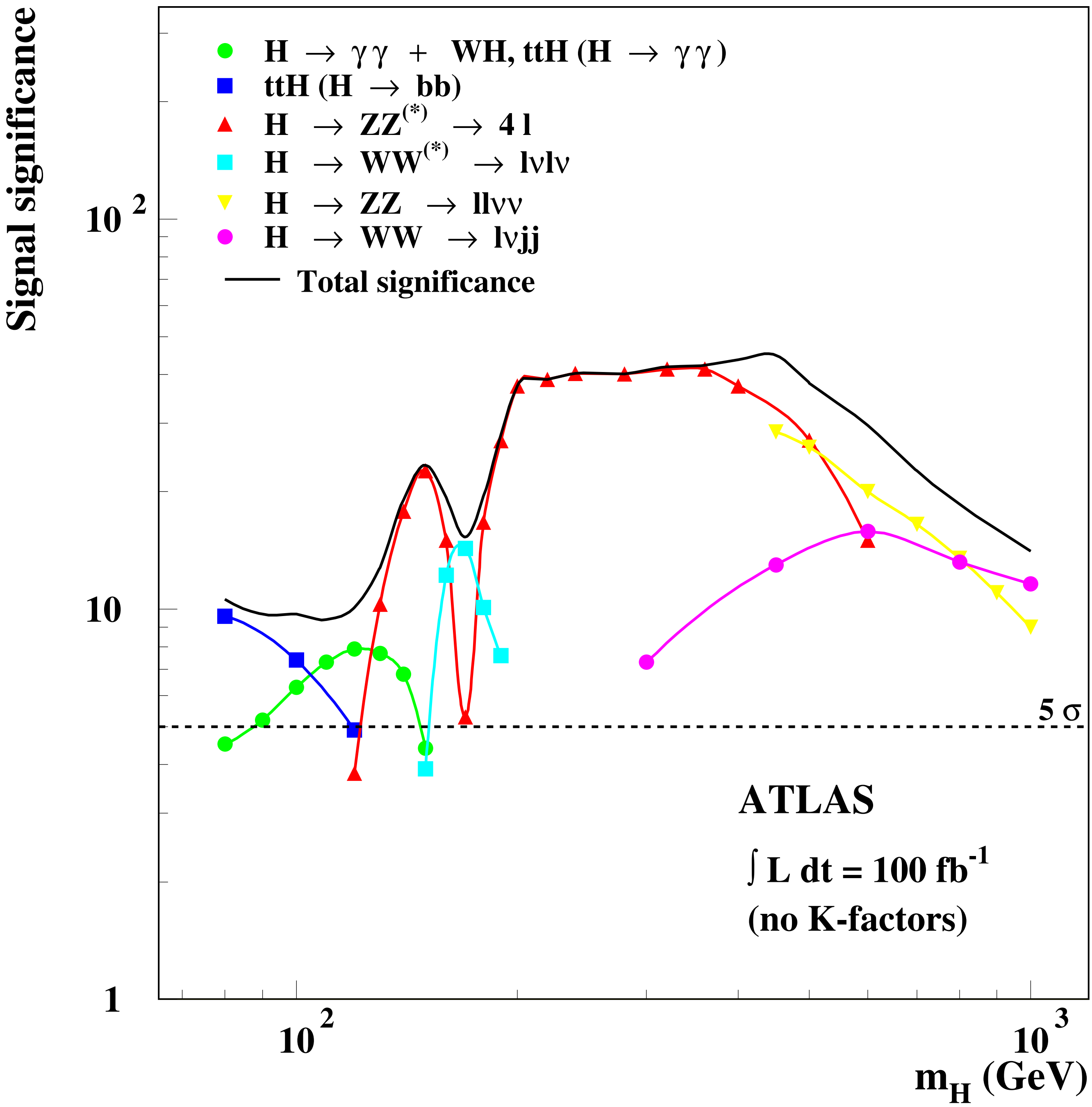
SM Higgs Search in CMS

Explorable mass range at $\sqrt{s}$ =14 TeV with 10^5 pb^{-1} taken at 10^{34} $cm^{-2}s^{-1}$

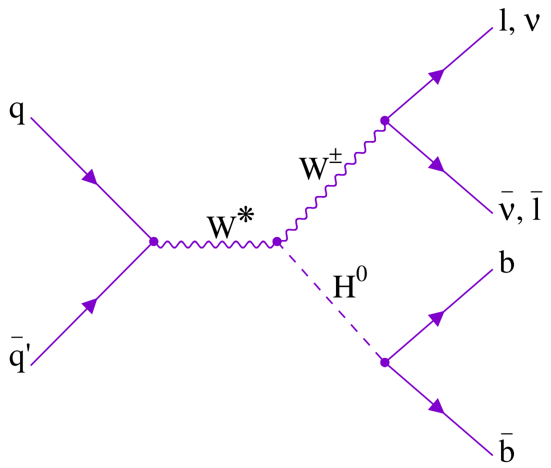


D.D. 809c

Standard Model Higgs



$W^{\pm}H^{0}$ Channel



◇ cross sections:

$\sigma_{W^{\pm}H^{0}} \times BR_{H^{0}\to b\bar{b}}$	$=$	1.28 - 0.54 pb
$m_{H^{0}}$	$=$	110 - 130 GeV/c^{2}
$\sigma_{W^{\pm}Z^{0}}$	$=$	18.2 pb
$\sigma_{W^{\pm}jj}$	$=$	27.1 nb
$\sigma_{t\bar{t}}$	$=$	569 pb
$\sigma_{t\bar{b}}$	$=$	318 pb

◇ event generator + fragmentation: PYTHIA (for S + B)

◇ observation only at high luminosity ⇒ pile up is included

◇ detector simulation: fast CMS response simulation “CMSJET”

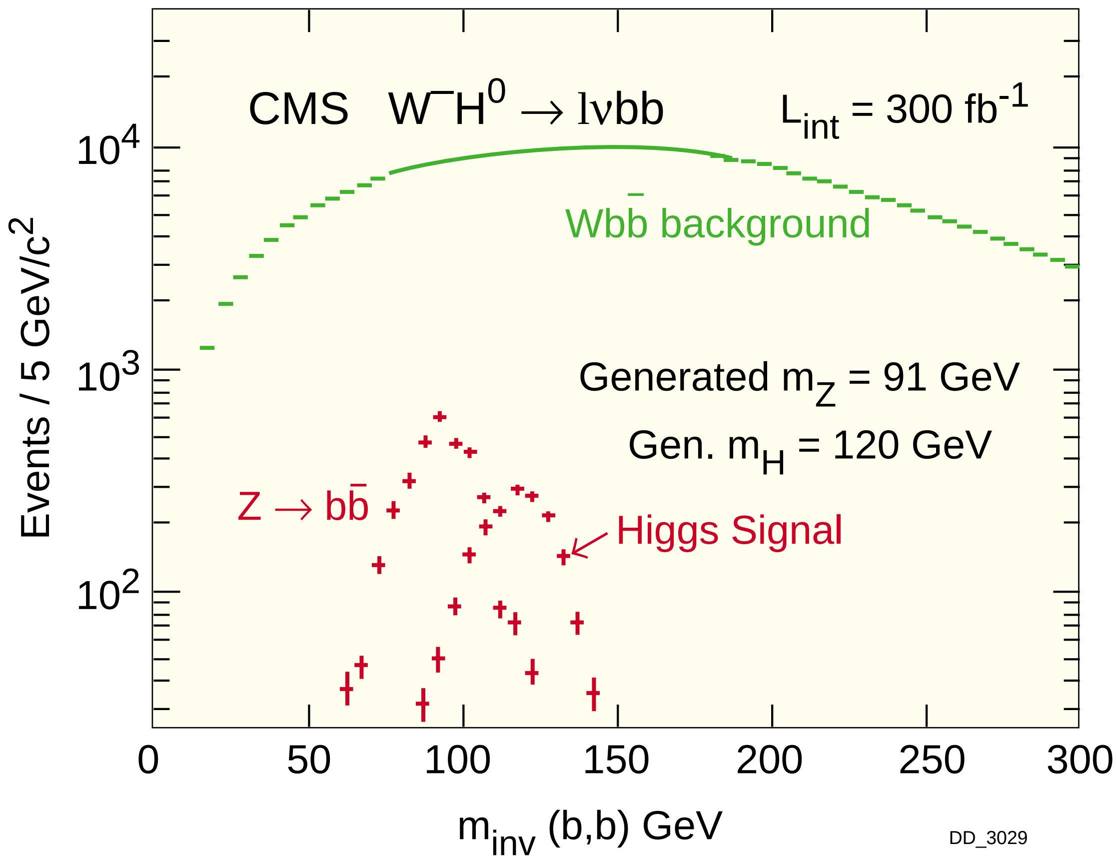
◇ trigger: 1 isol. $e^{\pm}$ or $\mu^{\pm}$ ($p_T > 20\ GeV$) and 2 jets ($E_T > 30\ GeV$)

◇ 2 tagged jets , jet veto , reconstruct $m_T(W^{\pm})$, E_T balance
signal to background ratio analysed with cut method

◇ mass window around the $m_{inv.}(b, \bar{b})$ peak

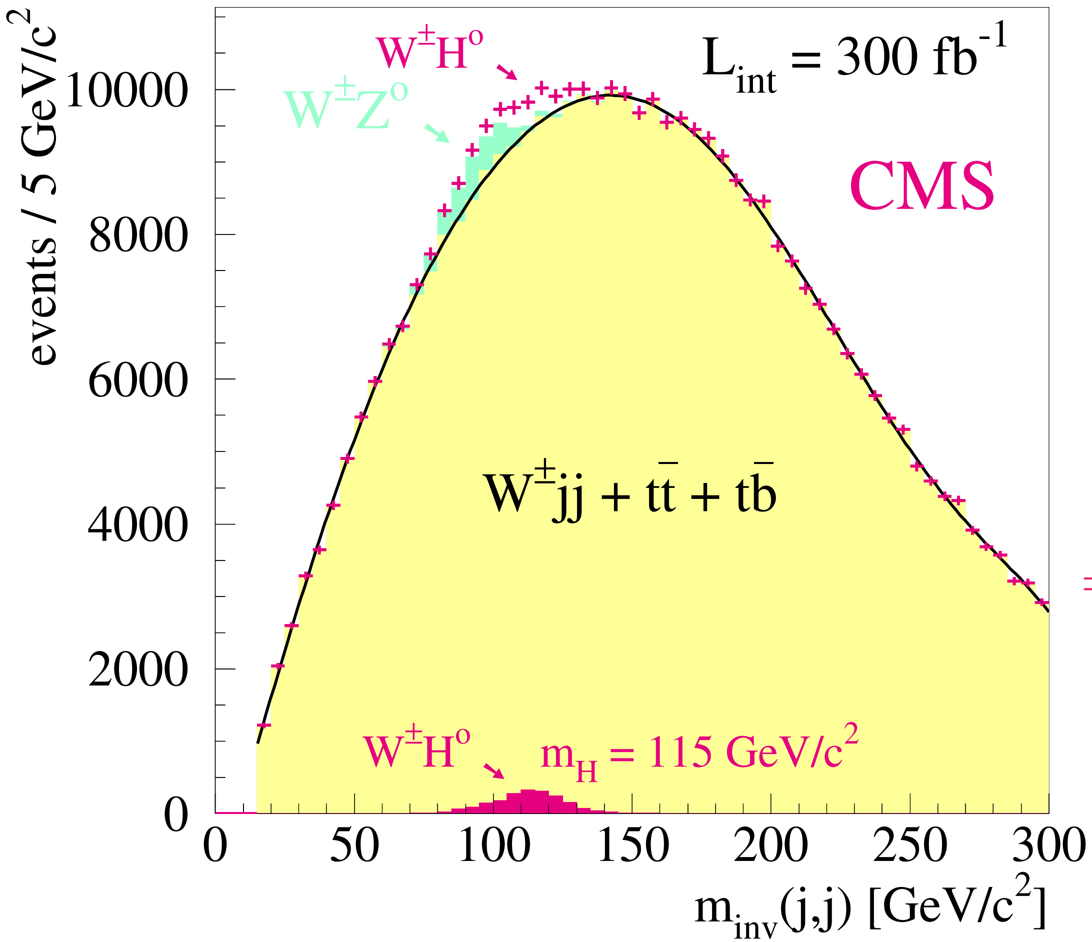
$H \to b\bar{b}$ in WH

$H \to b\bar{b}$ signal and backgrounds



$$W^{\pm} H^0_{SM} \to l^{\pm} \nu b\bar{b}$$

$$m_{H^0} = 115 \; GeV/c^2$$



◇ $97 < m < 130 \; GeV/c^2$:

N_{H115}	=	1610
$N_{W^{\pm}Z^0}$	=	1198
$N_{W^{\pm}jj}$	=	27565
$N_{t\bar{t}}$	=	36089
$N_{t\bar{b}}$	=	6096
N_{BG}	=	70948

⇒ results (stat.):

$S/B = 2.3\%$

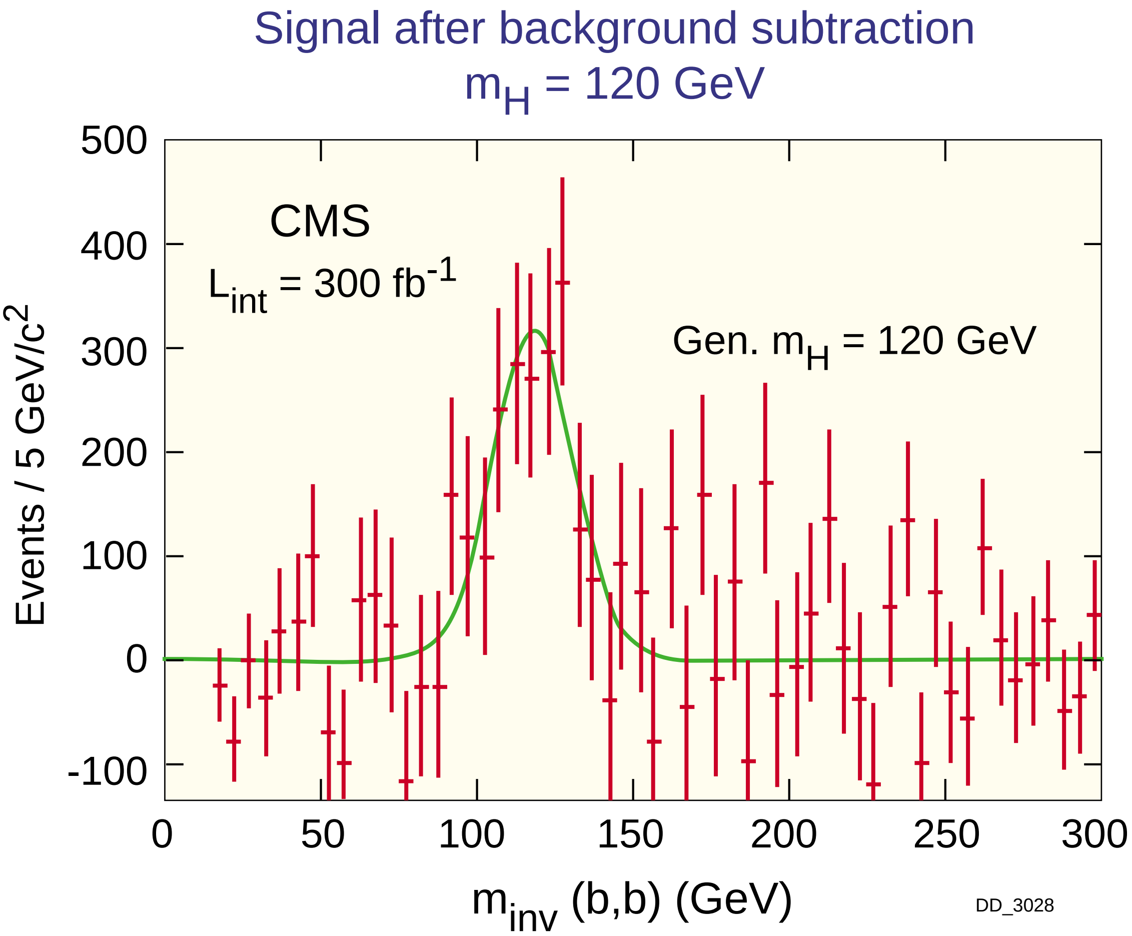
$S/\sqrt{B} = 6.0$

$\frac{\Delta g_{WWH}}{g_{WWH}} = 8.4\%$

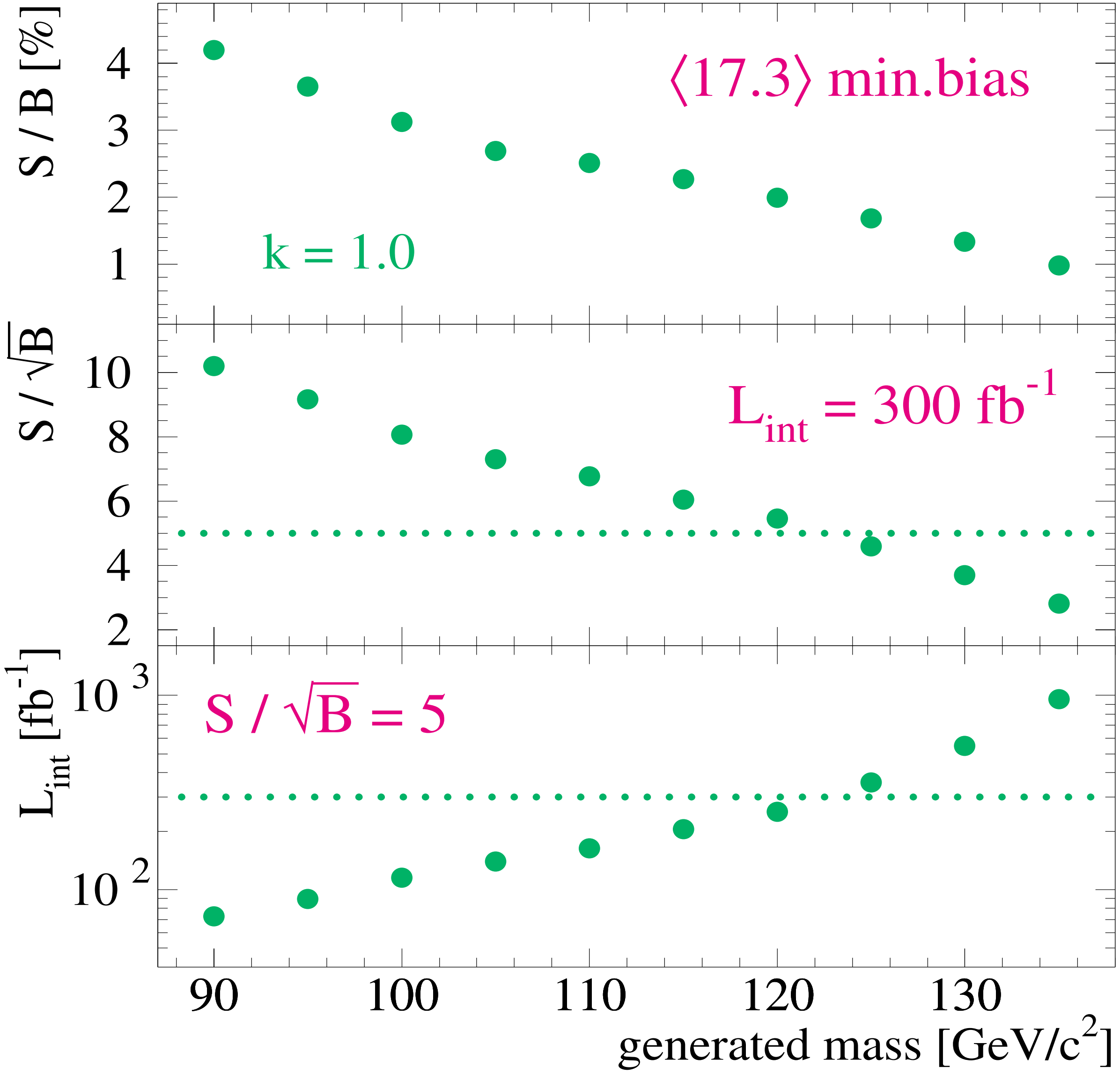
$\Delta m/m = 2.3\%$

◇ signal over background is low ⇒ need to subtract the background

$H \rightarrow b\bar{b}$ in WH



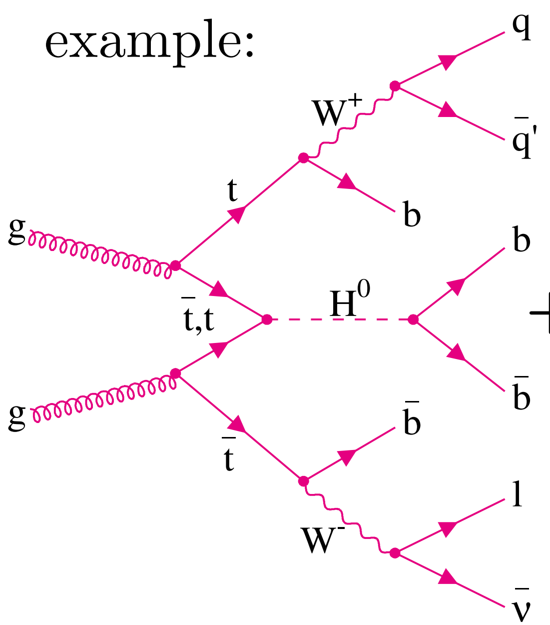
Sensitivity for $W^{\pm} H^0_{SM} \rightarrow l^{\pm} \nu b\bar{b}$



- ◇ S/B is low and decreases with increasing m_{H^0}
- ◇ $S/\sqrt{B} \geq 5$ for $m_{H^0} \leq 123\ GeV/c^2$ and $L_{int} = 300\ fb^{-1}$

$t\bar{t}H^0$ Channel

example:



$+ \ldots$

◇ cross sections:

$\sigma_{t\bar{t}H^0} \times BR_{H^0 \to b\bar{b}}$	$=$	0.78 - $0.32\ pb$
m_{H^0}	$=$	110 - 130 GeV/c^2
$\sigma_{t\bar{t}Z^0}$	$=$	$0.65\ pb$
$\sigma_{t\bar{t}b\bar{b}}$	$=$	$3.28\ pb$
$\sigma_{t\bar{t}jj}$	$=$	$507\ pb$

$\Rightarrow$ get $k_{t\bar{t}q\bar{q}} = 1.9$, introduce $k_{t\bar{t}H^0, t\bar{t}Z^0} = 1.5$

◇ generator for signal + BGs: CompHEP , fragmentation: PYTHIA

◇ detector simulation: fast CMS response simulation “CMSJET” with parametrisations based on detailed GEANT simulations

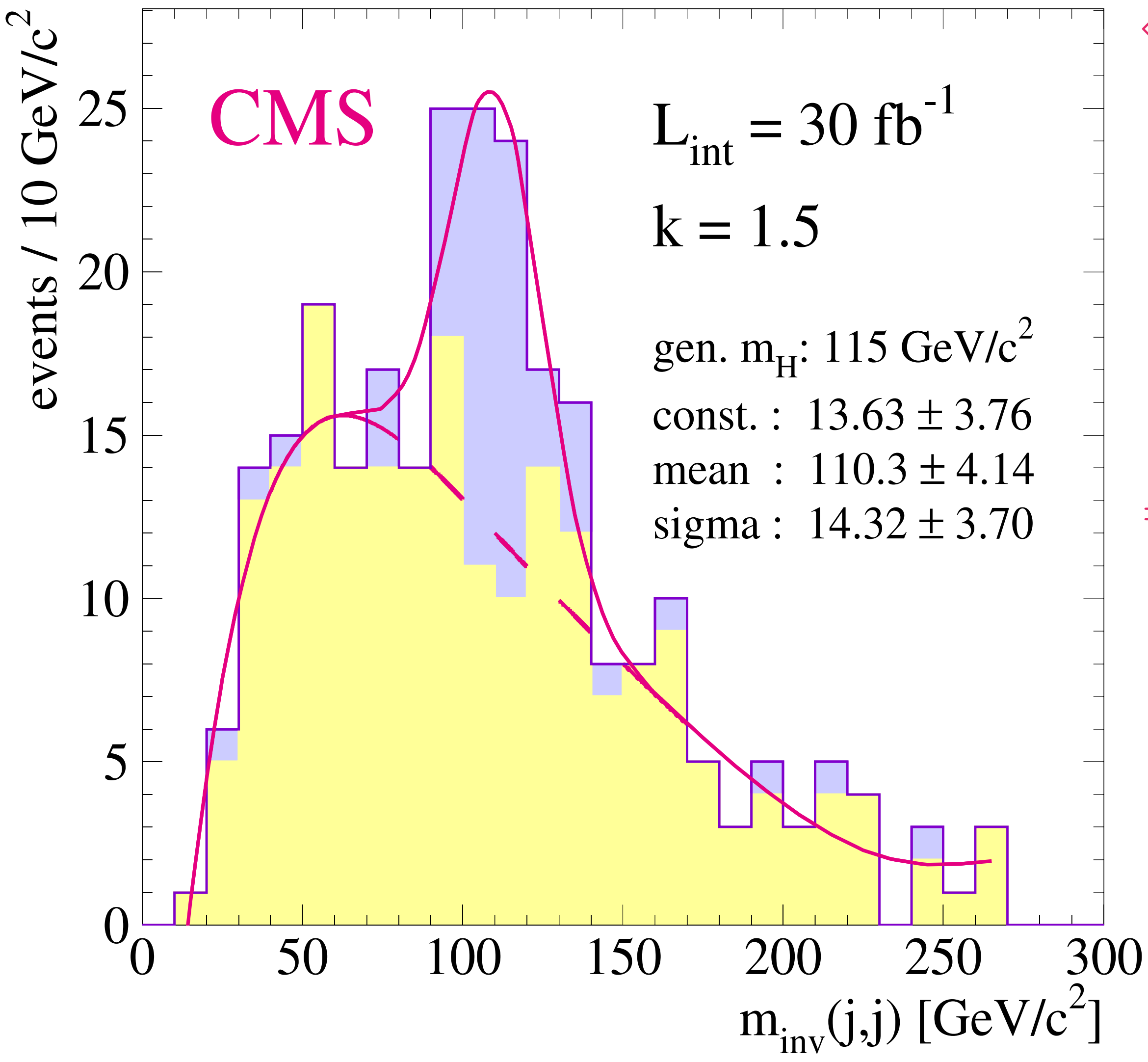
◇ trigger: 1 isol. $e^{\pm}$ or $\mu^{\pm}$ ($p_T > 10\ GeV$) and min. 6 jets ($E_T > 20\ GeV$)

◇ tag b-jets , reconstruct resonances (+ some kinematic cuts)
maximum likelihood method is used for S / B optimisation

◇ mass window around the $m_{inv.}(b, \bar{b})$ peak

$$t\bar{t}H^0_{SM} \rightarrow l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b}$$

$$m_{H^0} = 115\ GeV/c^2$$



◇ $90 < m < 130\ GeV/c^2$:

N_{H115}	=	38
$N_{t\bar{t}Z^0}$	=	3
$N_{t\bar{t}b\bar{b}}$	=	23
$N_{t\bar{t}jj}$	=	26
N_{BG}	=	52

⇒ results (stat.):

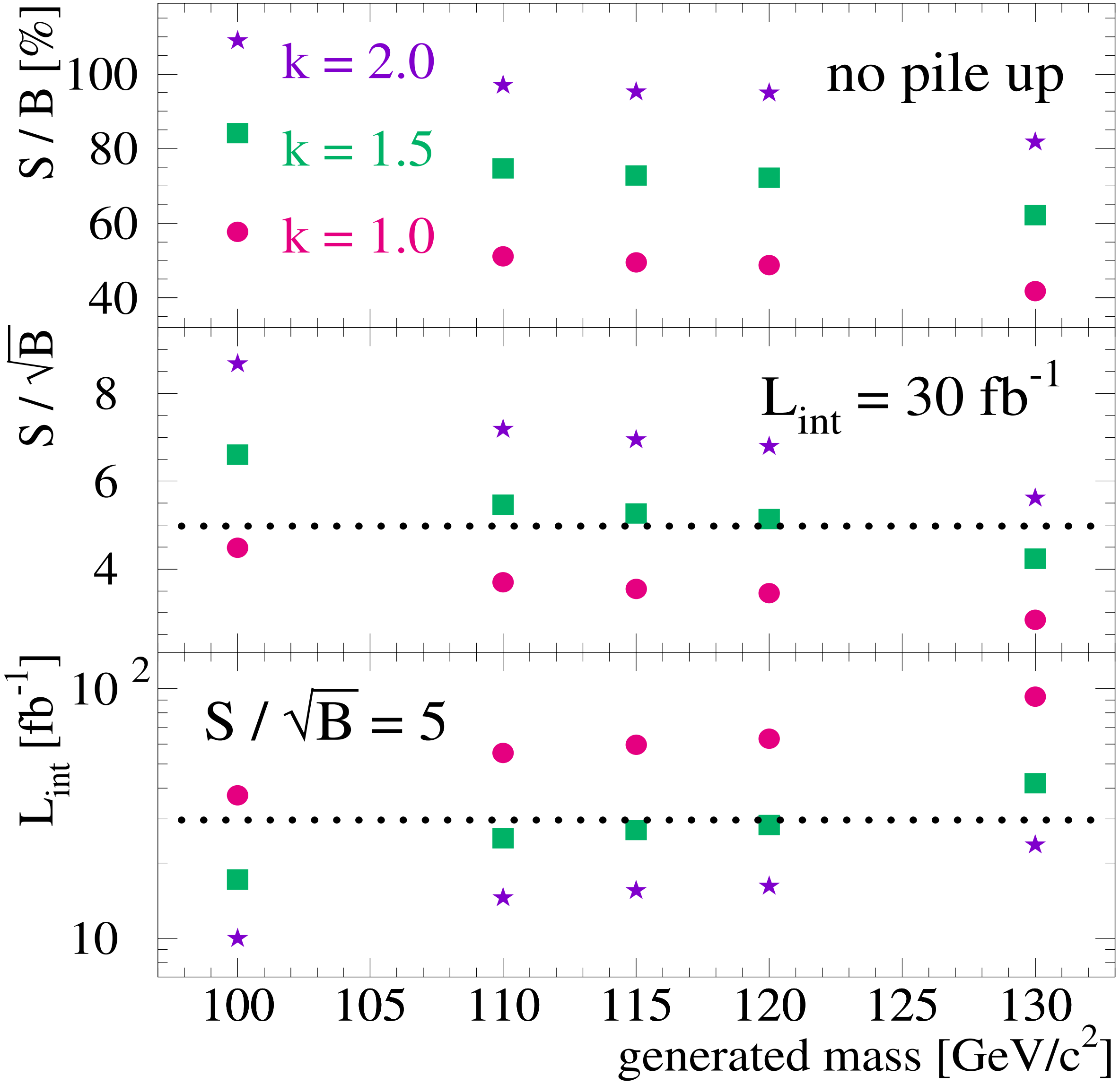
$S/B = 73\%$

$S/\sqrt{B} = 5.3$

$\Delta y_t/y_t = 13\%$

$\Delta m/m = 3.8\%$

Sensitivities for $t\bar{t}H^0_{SM} \rightarrow l^{\pm}\nu q\bar{q}b\bar{b}b\bar{b}$



- ◇ S/B is quite high - need no BG subtraction
- ◇ $S/\sqrt{B} = 5$ at 95/122/135 GeV/c^2
- ◇ visible signal already at low luminosity

$H \to \gamma\gamma$

A $\gamma\gamma$ mass resolution of †1 GeV at $m_{\gamma\gamma}$ = 100 GeV is needed

NLO cross sections

with kinematic cuts ($p_t^{\gamma 1} > 40$ GeV, $p_t^{\gamma 2} > 25$ GeV, $|\eta| < 2.5$)

and isolation

Signal:

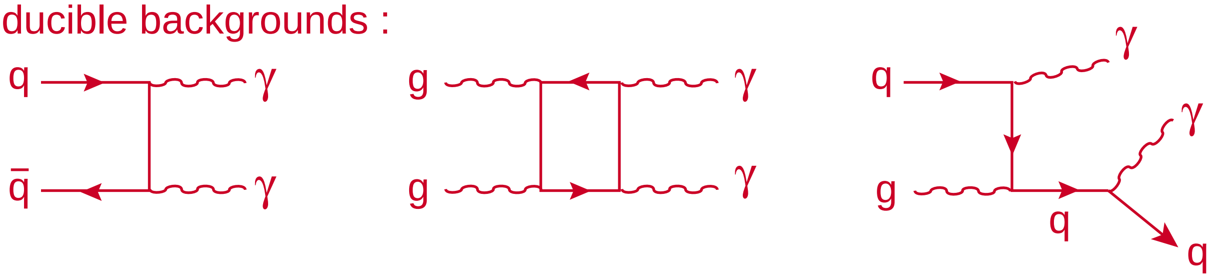
$H \to \gamma\gamma$, m_H = 100 GeV, $\sigma * BR$: 86.1 fb

Backgrounds:

Irreducible $\gamma\gamma$ backgrounds (at $m_{\gamma\gamma}$ = 100 GeV) :

$qq \to \gamma\gamma$	92 fb / GeV
$gg \to \gamma\gamma$	167 fb / GeV
Isolated bremstrahlung	120 fb / GeV

irre ducible backgrounds :

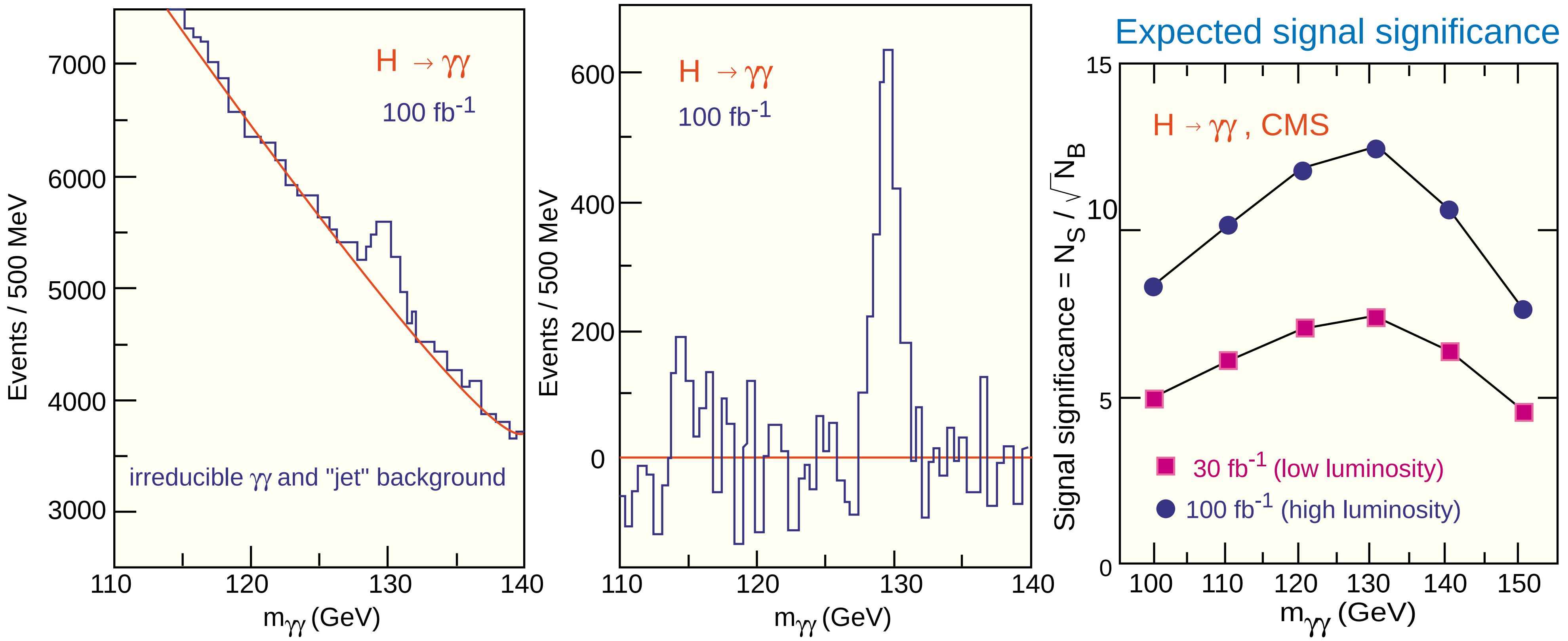


Main reducible backgrounds from γ + jet (with "jet" = "π^0" = "γ")

† 15 % of irreducible $\gamma\gamma$ background

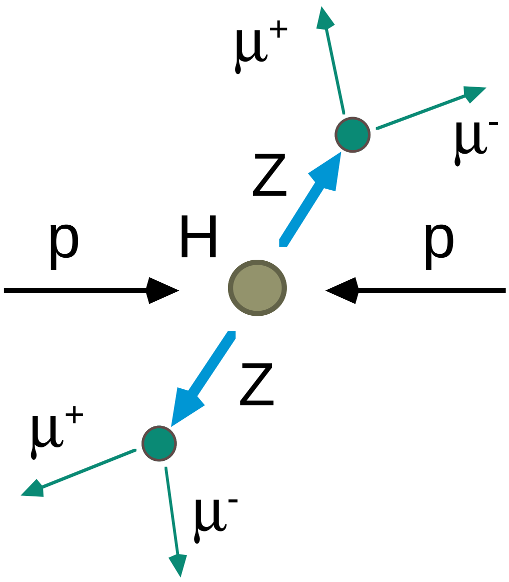
D_D_1264c

$H_{SM} \to \gamma\gamma$ in CMS $PbWO_4$ calorimeter



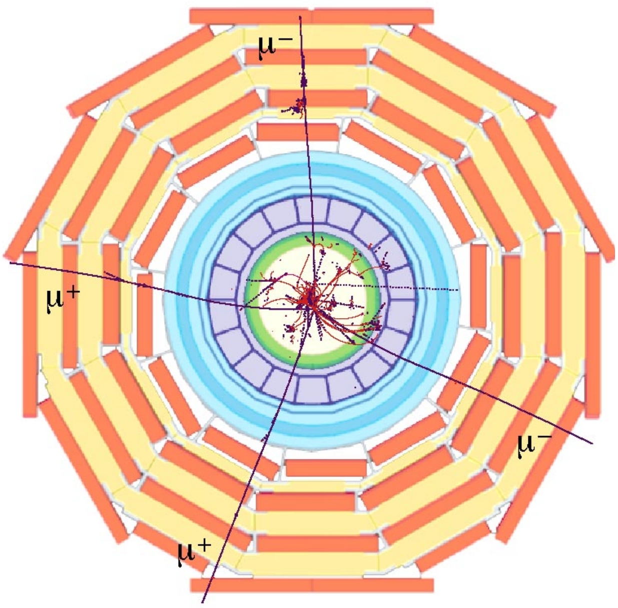
D_D_1205c.mod

Higgs to 4 leptons (140 < M_H< 700 GeV)

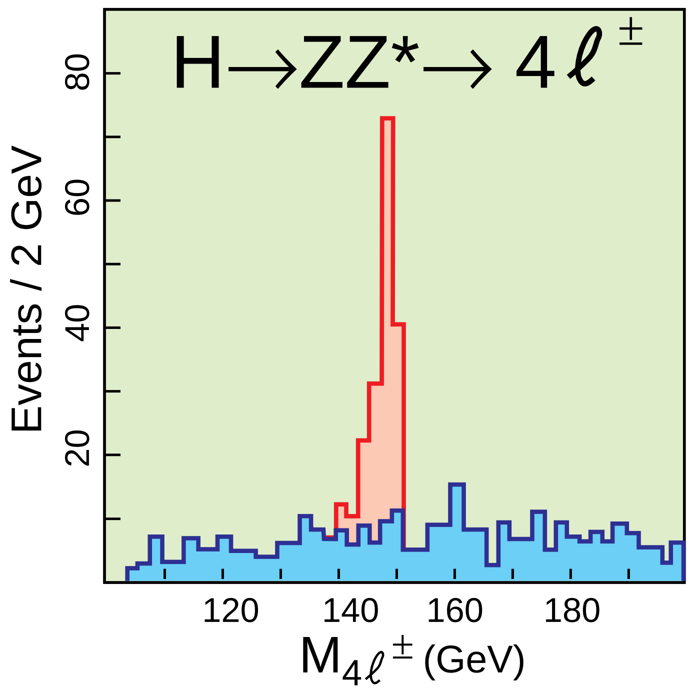


In the M_H range 130 - 700 GeV the most promising channel is $H^0 \rightarrow ZZ^* \rightarrow 2\ell^+ 2\ell^-$ or $H^0 \rightarrow ZZ \rightarrow 2\ell^+ 2\ell^-$. The detection relies on the excellent performance of the muon chambers, the tracker and the electromagnetic calorimeter.

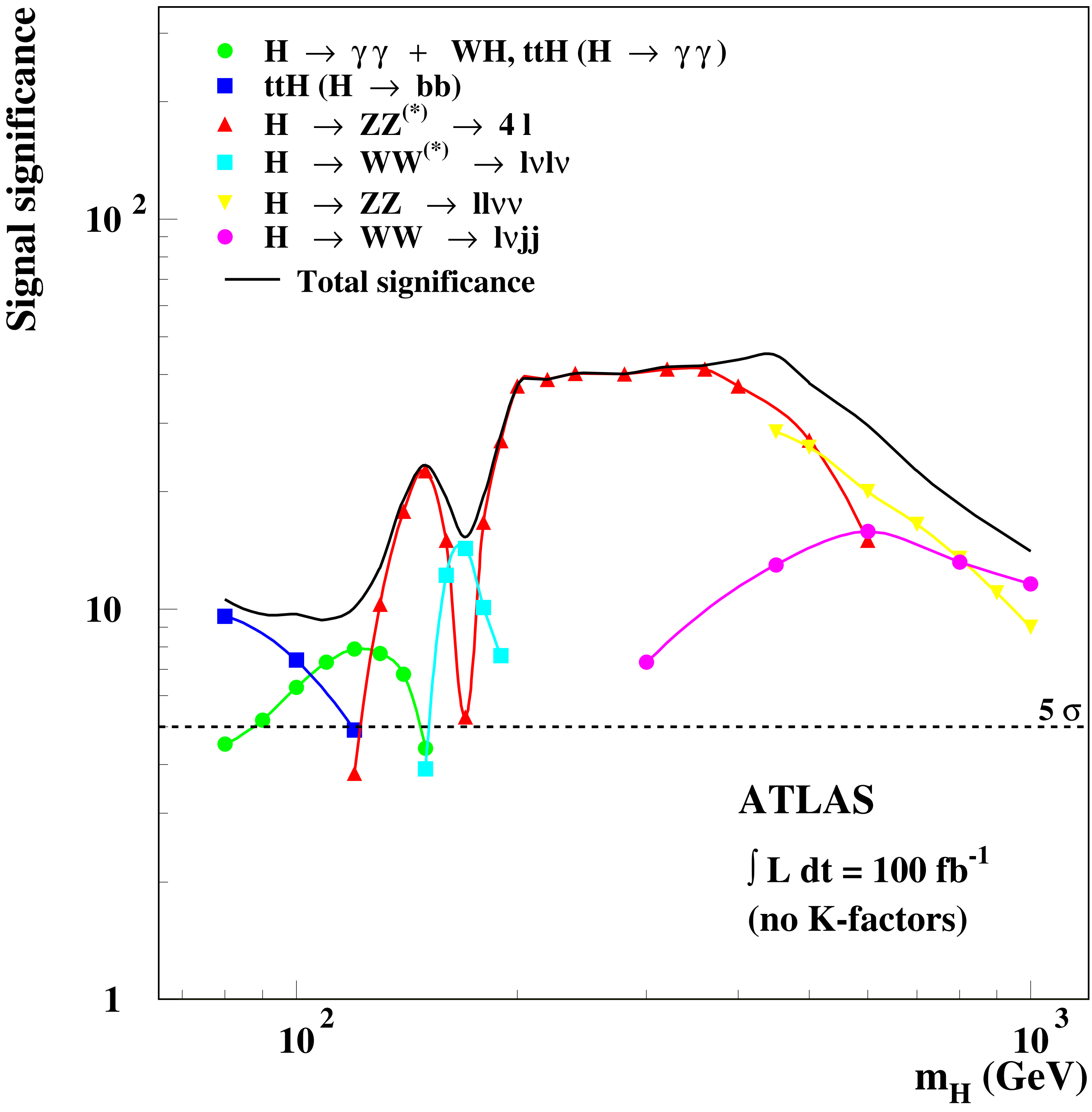
For $M_H \leq 170$ GeV a mass resolution of ~1 GeV should be achieved with the combination of the 4 Tesla magnetic field and the high resolution of the crystal calorimeter



M_{Higgs} = 150 GeV

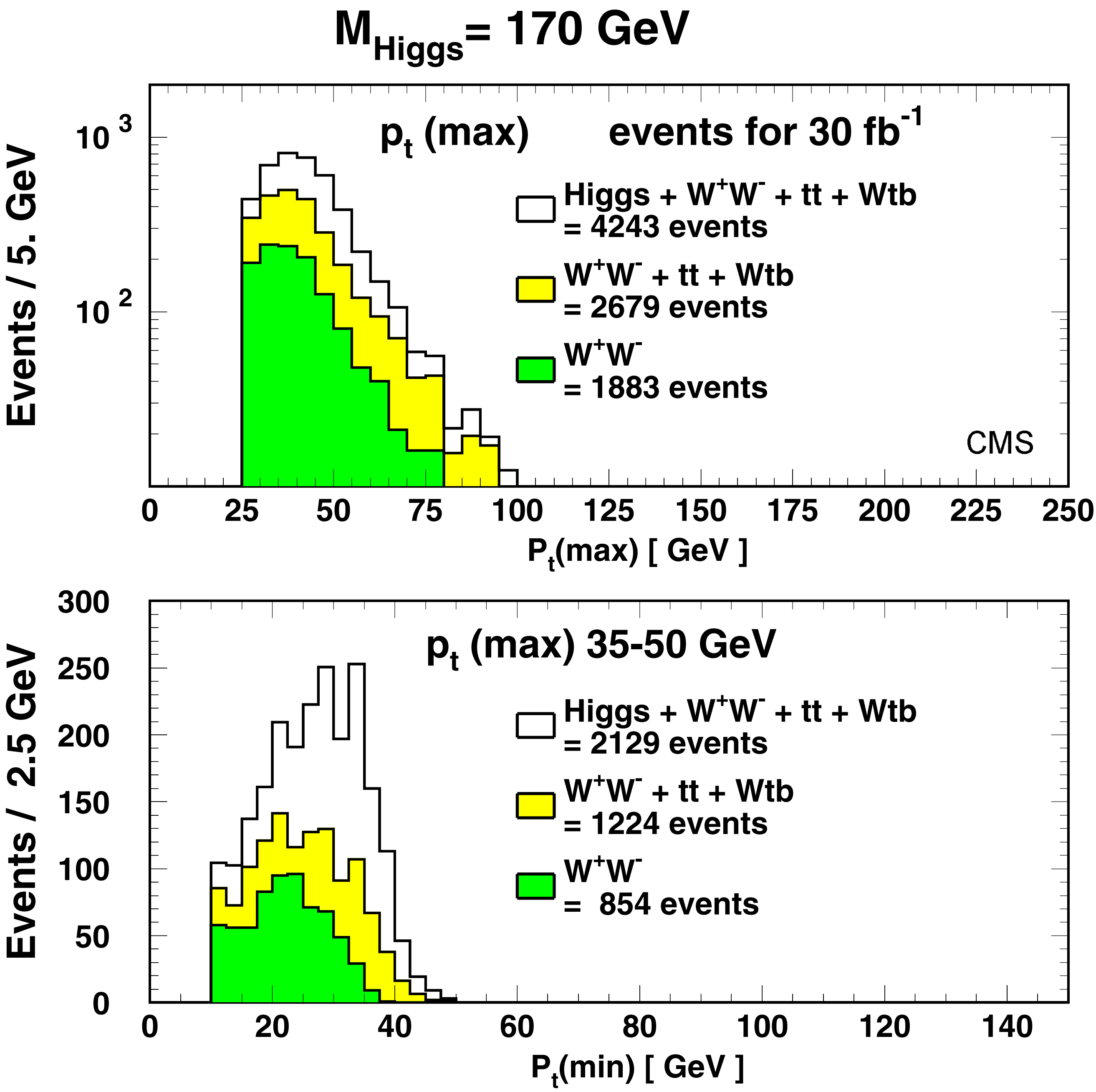


Standard Model Higgs



$H_{SM} \to WW \to l\nu\, l\nu$

lepton p_T distributions



$H \to WW^{(*)} \to l\nu l\nu$ selection criteria

1. Two isolated leptons:

   $P_T^1 > 20$ GeV, $P_T^2 > 15$ GeV and $|\eta| < 2.5$;

2. Two tag jets:

   $P_T^1 > 40$ GeV, $P_T^2 > 20$ GeV and $\Delta\eta_{tags} = |\eta_{tag}^1 - \eta_{tag}^2| > 3.8$;

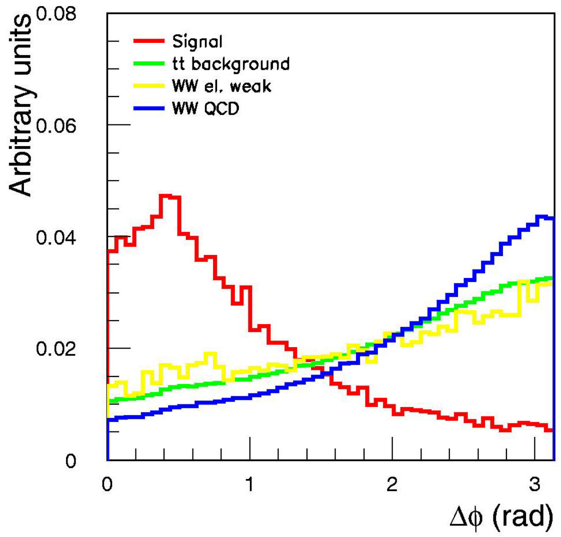
   $\eta_{tag}^{min} < \eta_{l_{1,2}} < \eta_{tag}^{max}$;

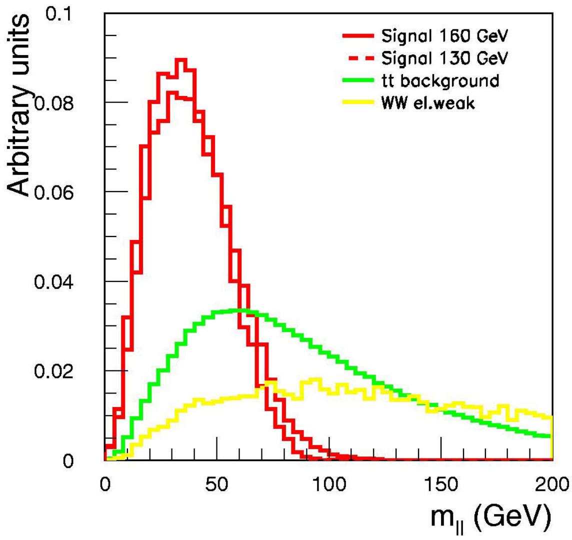
   Tag jets should not be b-jets
   $\Rightarrow$ b-jet veto ($\epsilon_b = 0.70$) for tag jets within $|\eta| < 2.5$

3. Lepton Angular and Di-lepton mass cuts:

   (exploit angular correlations (Spin-0 Higgs $\to$ Spin-1 W's)
   $\Rightarrow$ leptons are expected to have a small angular separation)

   $\Delta\phi_{ll} \leq 1.05$, $\Delta R_{ll} \leq 1.8$, $\cos\theta_{ll} \geq 0.2$
   $M_{ll} < 85$ GeV, $P_T(l_{1,2}) < 120$ GeV

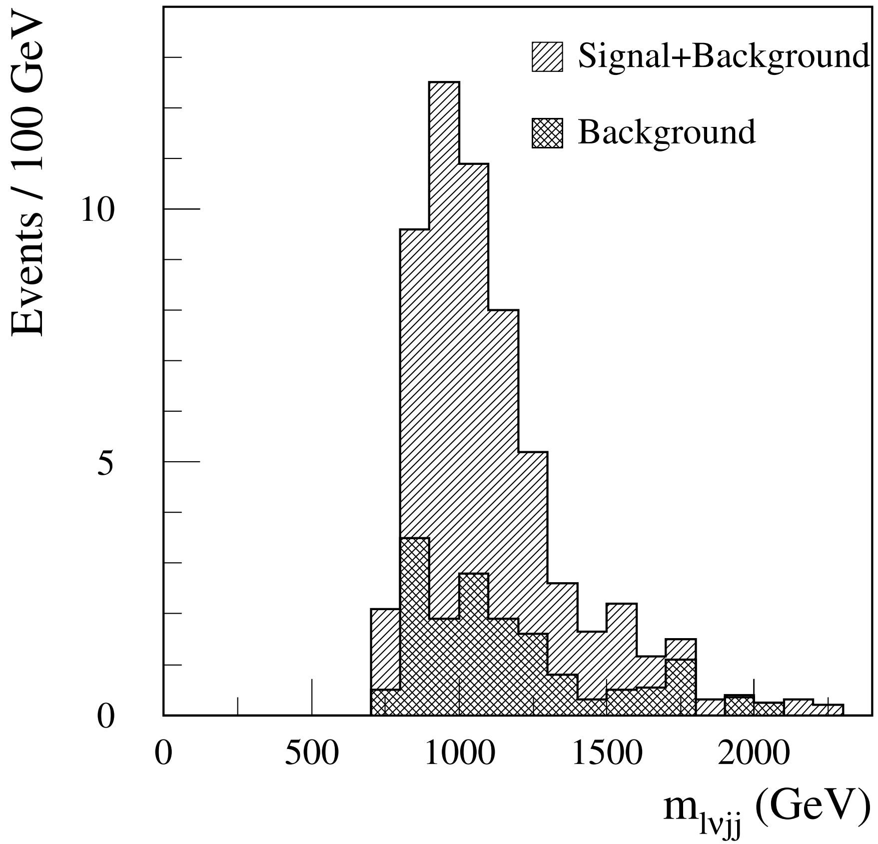




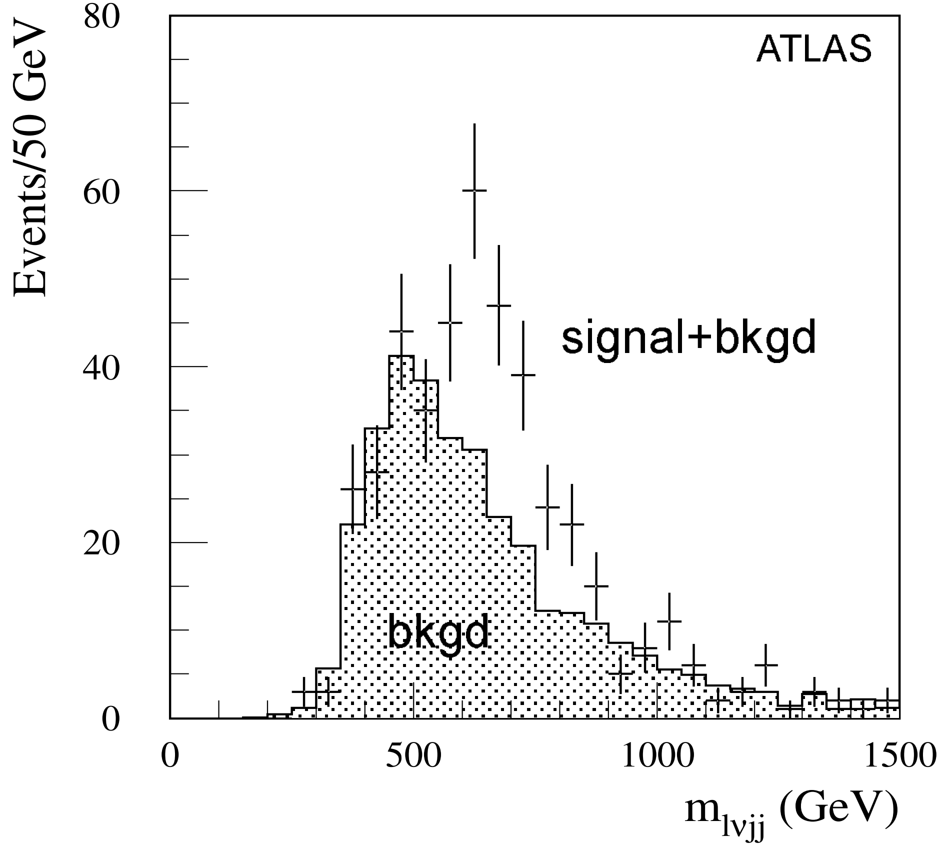
$H_{SM} \to WW \to l\nu\, jj$

30 fb^{-1}

M_H = 1000 GeV



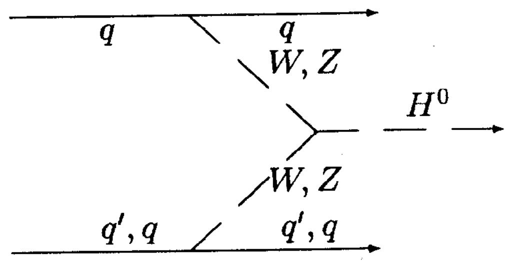
M_H = 600 GeV



Higgs production via Weak Boson Fusion

Motivation:

•Additional potential for Higgs boson discovery at low masses
•Important for the measurement of Higgs boson parameters



(couplings to bosons, fermions (taus), total width)

Several papers by D.Zeppenfeld et al.. Phys.Rev.D60:113004,1999; Phys.Lett.B454:297-303,1999; Phys.Rev.D59:014037,1999, Phys.Rev. D62 (2000)

σ = 4 pb (20% of total cross section for m_H = 120 GeV)

however: **- two high P_T forward jets**

- small jet activity in the central region

H→WW*->ll +X mH=150-180 GeV

sensitivity above 4.5σ for 5fb-1
very good S/B ratio, observe excess of events in the transverse mass

H->ττ - > l h, l l + X mH = 120-140 GeV

requires 30 fb-1 and combination of both modes

mass reconstruction of the ττ system possible.

Results on couplings measurement still not completed....

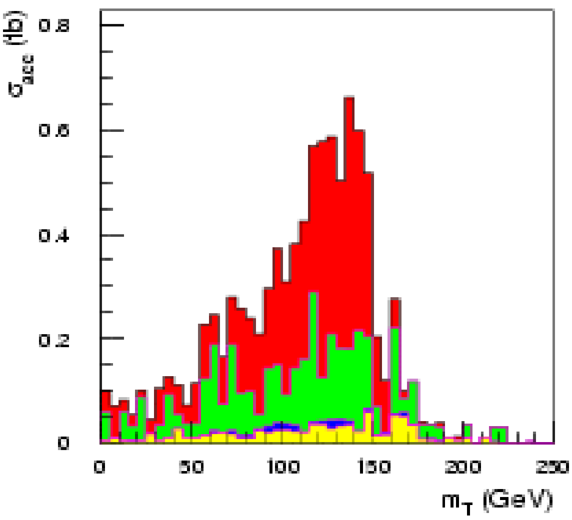
$qqH \rightarrow qqWW \rightarrow qq\ l\nu\ l\nu$

10 fb-1

Counting experiment

For 5 fb –1 expect:

mH =	130	150	170
S =	5	14	22
B =	4	4	5
Sig. =	2.0	4.7	6.5



$$m_T = \sqrt{2 p_T^{\ell\ell} E_T^{miss} (1-\cos\Delta\varphi)}$$

$qqH \rightarrow qq\ \tau\tau \rightarrow qq\ l\nu\nu\ l\nu\nu$

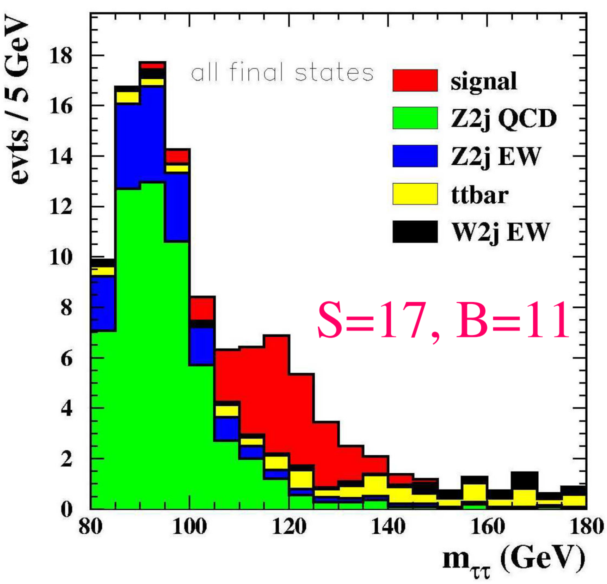
tau reconstruction possible using colinear approximation

30 fb-1

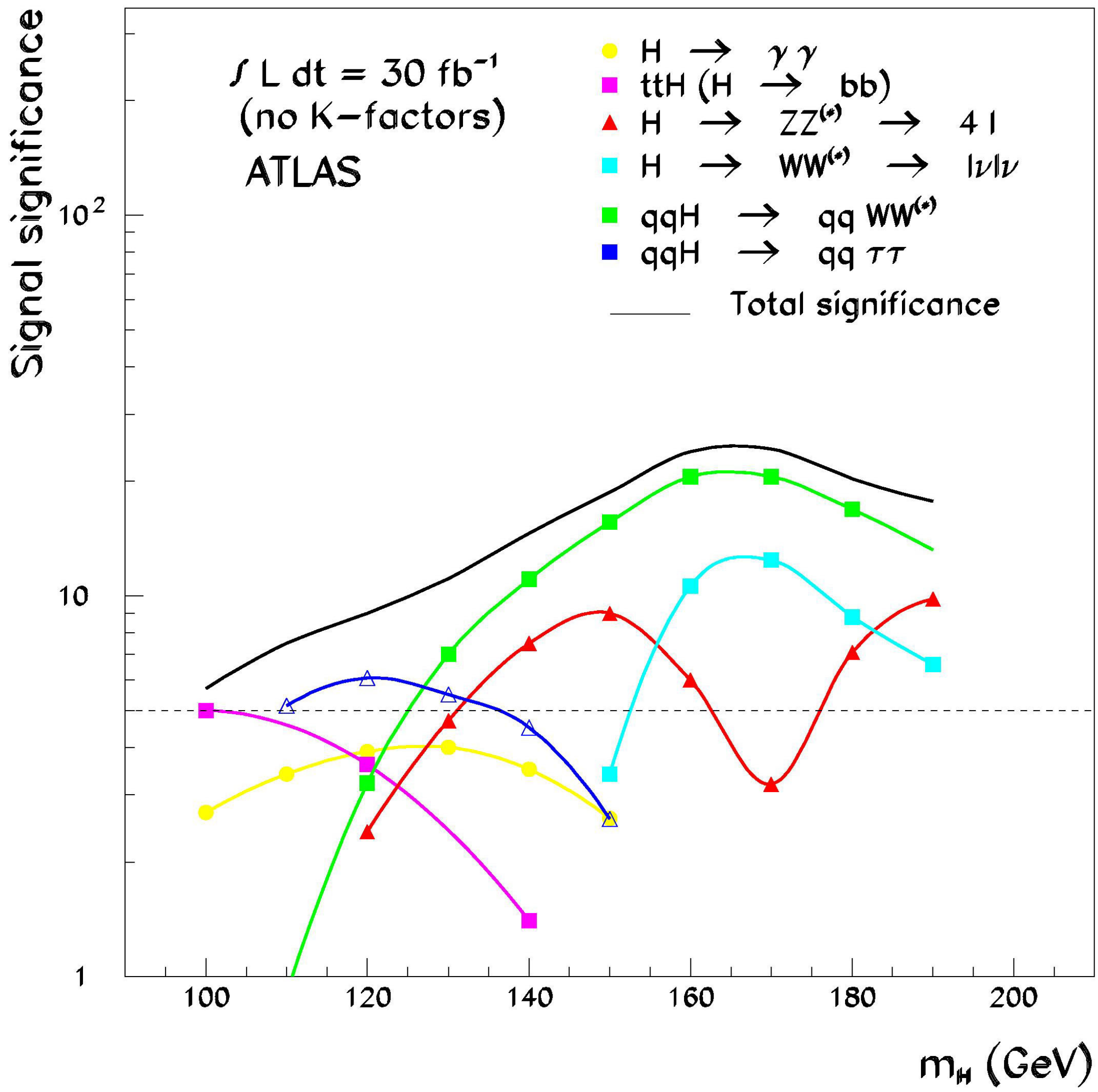
For 30 fb –1 expect:
(e, mu)

mH =	120	130	140
S =	7	5	3
B =	3	2	2
Sig. =	3.2	2.5	1.8

all final states



ATLAS Higgs discovery potential for 30 fb^{-1}



- Vector boson fusion channels improve the sensitivity significantly in the low mass region
- Several channels available over the full mass range

  (important for Higgs boson parameter determination)

Available on CMS information server

CMS NOTE 2000/060

The Compact Muon Solenoid Experiment

CMS Note

Mailing address: CMS CERN, CH-1211 GENEVA 23, Switzerland

December 22, 2000

Heavy Ion Physics Programme in CMS

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Chapter 7

$\gamma\gamma$ Physics

7.1 General introduction

The physics of central collisions is the physics of the Quark Gluon Plasma. Apart from projects like the search for new physics at very high rapidities (see the CASTOR subproject at ALICE for a search for Centauro events at the LHC), “Non QGP Physics” may be defined as the physics of peripheral collisions, which includes the effects of coherent photons and diffraction effects (Pomeron exchange). It is our aim to show that CMS can address very interesting physics topics in a rather clean way.

Central collision events are characterized by a very high multiplicity. Conversely, the multiplicity in peripheral collisions is comparatively low. The ions do not interact directly with each other and move on essentially undisturbed in the beam direction. The only possible interaction are therefore due to the long range electromagnetic interaction and diffractive processes. Due to the coherent action of all the protons in the nucleus, the electromagnetic field is very strong and the resulting flux of equivalent photons is large, proportional to Z^2, where Z is the nuclear charge. Due to the very short interaction times the spectrum of these photons extends up to about 100 GeV in the laboratory system. The coherence condition limits the virtuality of the photon to very low values of $Q^2 < 1/R^2$, where $R = 1.2\ A^{1/3}$fm is the nuclear radius.

Hard diffractive processes in heavy ion collisions have also been studied. These are interesting processes on their own, but they are also a possible background to photon-photon and photon-hadron interactions. The physics potential of such kind of collisions is discussed in Section 7.2, in an extension of CMS note1998/009. It ranges from studies in QCD and strong field QED to the search for new particles like a light Higgs. This kind of physics is strongly related to $\gamma\gamma$ physics at e^+e^- colliders with increased luminosity. In view of the strong interaction background, experimental conditions will be somewhat different from the $\gamma\gamma$ physics at e^+e^- colliders. A limitation of the heavy ions is that only quasireal but no highly virtual photons will be available in the AA collisions.

Another interesting possibility is the study of photon-hadron interactions, extending the γp interaction studies at HERA/DESY to γA interactions, and reaching higher invariant masses than those possible at HERA.

At the STAR (Solenoidal Tracker At RHIC) detector – which began operations in June 2000 – a similar program of photon and Pomeron interaction studies exists. At RHIC the photon flux will be of the same order of magnitude but the spectrum is limited to about 3 GeV.

7.2 Photon-photon and photon-hadron physics

The parton model is very useful to study scattering processes at very high energies. The scattering is described as an incoherent superposition of the scattering of the various constituents. For example, nuclei consist of nucleons which in turn consist of quarks and gluons, photons consist of lepton pairs, electrons consist of photons, etc.. We note that relativistic nuclei have photons as an important constituent, especially for low enough virtuality $Q^2 = -q^2 > 0$ of the photon. This is due to the coherent action of all the charges in the nucleus. The virtuality of the photon is related to the size R of the nucleus by

$$Q^2 \lesssim 1/R^2 \tag{7.1}$$

Table 7.2: Parameters A and B (see Eq. (7.30)) and the resulting total cross sections for the bound-free pair production for RHIC and LHC. The parameters are taken from Ref. [291].

Ion	A	B	$\sigma(\gamma = 106)$	$\sigma(\gamma = 2950)$
Pb	15.4b	−39.0b	115 b	222 b
Au	12.1b	−30.7b	90 b	173 b
Ca	1.95mb	−5.19mb	14 mb	27.8 mb
O	4.50μb	−12.0μb	32 μb	64.3 μb

We note that the electron and positron can also form a bound state, positronium. This is in analogy to the $\gamma\gamma$ production of mesons discussed in Section 7.2.3. With the known width of the parapositronium $\Gamma((e^+e^-)_{n=1}{}^1S_0 \to \gamma\gamma) = mc^2\alpha^5/2$, the photon-photon production of this bound state was calculated [300]. The production of orthopositronium, $n = 1^3S_1$ was also calculated recently [301]. As discussed in Section 7.2.3 the production of orthopositronium is only suppressed by the factor $(Z\alpha)^2$ which is not very small. Therefore one expects that both kind of positronium are produced in similar numbers. Detailed calculation show that the three-photon process is indeed not much smaller than the two-photon process [301, 302].

7.2.7 Event rates at CMS

An overview of the expected event rate for a number of different photon-photon reactions to either discrete states or continuum states is given in the following figures. The y axis on the right hand sides show both the number of events per second and per 10^6 s. We use beam luminosities of $10^{26}\text{cm}^{-2}\text{s}^{-1}$ for Pb+Pb and $4 \times 10^{30}\text{cm}^{-2}\text{s}^{-1}$ for Ca+Ca. The resonances have been calculated using the masses and photon-decay widths given in Table 7.2.4. For the calculation of the rate for a standard model Higgs boson, we use the approach discussed in Ref. [259]. H' denotes a nonstandard Higgs as given in the "general two-Higgs doublet model" [263]. Because its photon-photon decay width is rather weakly dependent on its mass in the relevant mass region, we have used a constant value of 0.1 keV in our calculations.

The total hadronic cross section $\sigma_{\gamma\gamma}(\text{hadron})$ is parameterized as [251]

$$\sigma_{\gamma\gamma}(\text{hadron}) = A(s/s_0)^{\epsilon} + B(s/s_0)^{-\eta} \tag{7.31}$$

with $s_0 = 1$ GeV^2, $\epsilon = 0.079$, $\eta = 0.4678$, $A = 173$ nb and $B = 519$ nb. For dilepton and $q\bar{q}$ production via $\gamma\gamma$, we have used the lowest order QED expression for point-like fermions. The heavy quark masses are $m_c = 1.1$ GeV and $m_b = 4.1$ GeV.

7.2.8 Selecting $\gamma\gamma$ events

The $\gamma\gamma$ luminosities are rather large but the $\gamma\gamma \to X$ cross sections are small compared to their hadronic counterparts, therefore, *e.g.*, the total hadronic production cross section for all events is still dominated by hadronic events. This makes it necessary to have an efficient trigger to distinguish photon-photon events from hadronic ones.

There are some characteristic features that make such a trigger possible. $\gamma\gamma$ events are characterized by the fact that both nuclei remain intact after the interaction. Therefore a $\gamma\gamma$ event will be characterized by a low multiplicity in the central region and no event in the very forward or backward directions (corresponding to fragments of the ions). The momentum transfer and energy loss for each ion are too small for the ion to leave the beam. It should be noted that in a $\gamma\gamma$ interaction with an invariant mass of several GeV leading to hadronic final states, quite a few particles will be produced, see, *e.g.*, Ref. [251]

A second characteristic is the small transverse momenta of the produced system due to the coherence condition $q_\perp < 1/R \approx 50$ MeV. If one is able to make a complete reconstruction of the momenta of all produced particles with sufficient accuracy, this can be used as a very good suppression at grazing collisions. As the strong interaction is short ranged, it has normally a much broader distribution in the transverse momenta. A calculation using the PHOJET event generator [303] to study processes in central and grazing collisions by Pomeron-exchange found an average transverse momentum of ~ 450 MeV, about a factor of 10 larger than the $\gamma\gamma$ events. In a study for the STAR experiment [304] it was also found that triggering for small transverse momenta is an efficient method to reduce the background coming from grazing collisions.

Another question that has to be addressed is the importance of diffractive events, that is, *e.g.* photon-Pomeron and Pomeron-Pomeron processes in ion collisions. From experiments at HERA one knows that the proton has a

Measurements of Higgs couplings

- Without theoretical input only measurment of the ratios of couplings possible

i) Ratio between couplings to bosons

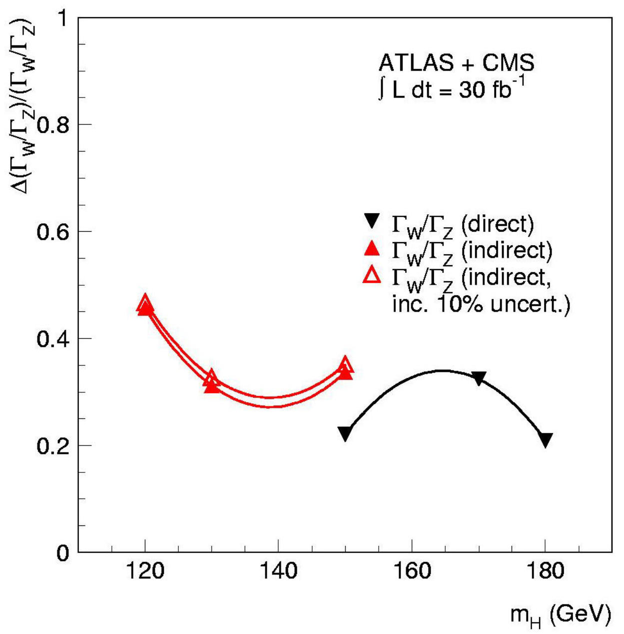
- Direct measurement $- \frac{\sigma \times BR(H \to WW^*)}{\sigma \times BR(H \to ZZ^*)} = \frac{\Gamma_g \Gamma_W}{\Gamma_g \Gamma_Z} = \frac{\Gamma_W}{\Gamma_Z}$

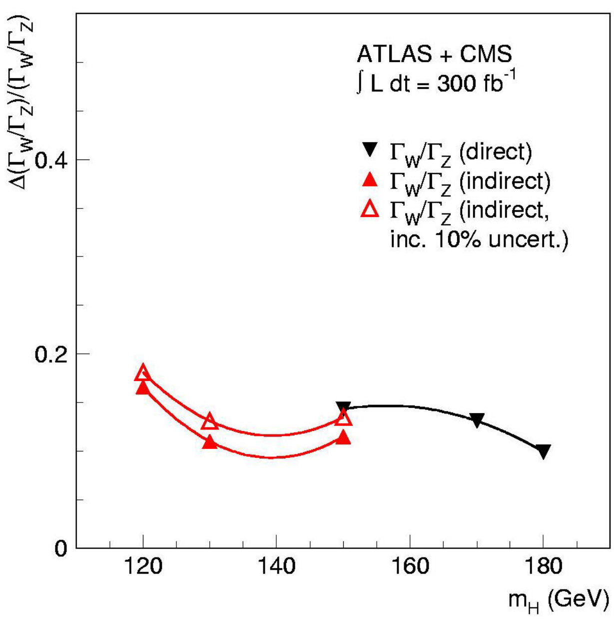
(QCD corrections cancel)

- Indirect measurement $- \frac{\sigma \times BR(H \to \gamma\gamma)}{\sigma \times BR(H \to ZZ^*)} = \frac{\Gamma_g \Gamma_\gamma}{\Gamma_g \Gamma_Z} \sim \frac{\Gamma_W}{\Gamma_Z}$

(Use proportionality between Γ_W and Γ_γ, needs theoretical input, 10% uncertainty assumed)

Results for 30 fb-1 and 300 fb-1 per experiment

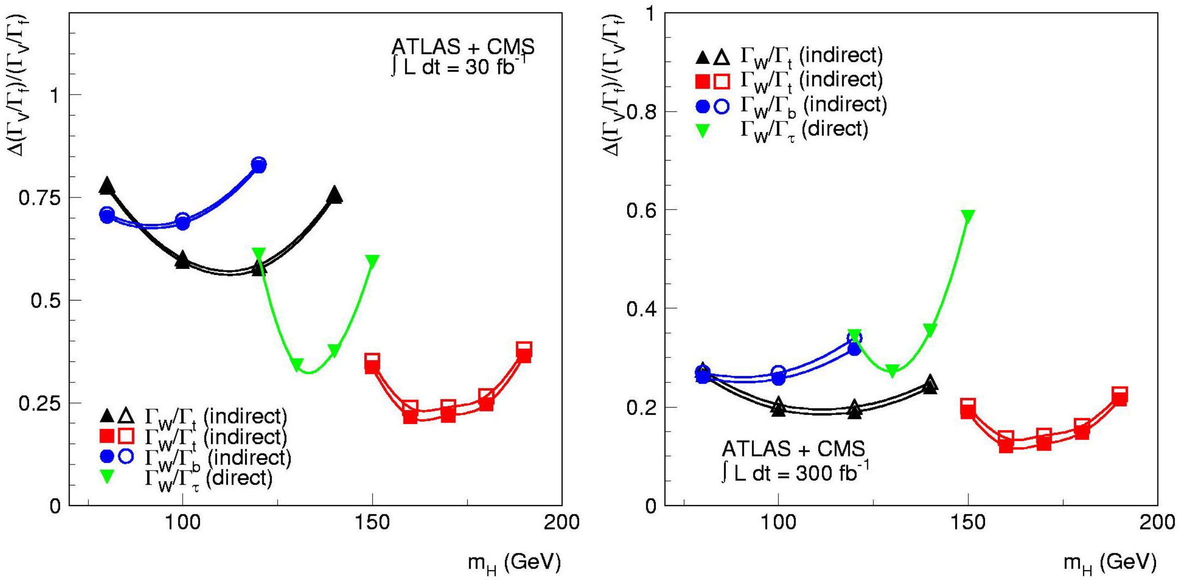




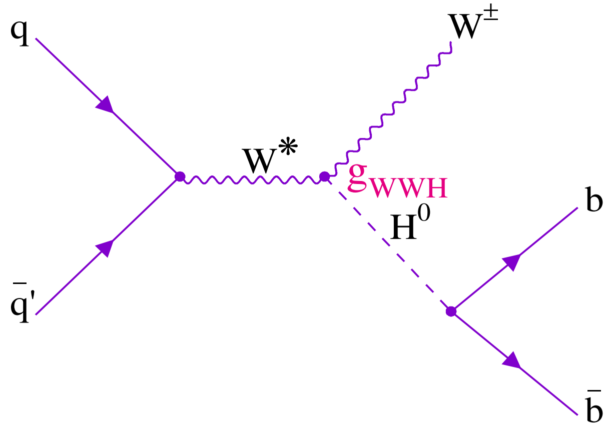
Ratios of boson/fermion couplings

- Direct measurement
  - $\frac{\sigma \times BR(qq \to qqH(H \to WW))}{\sigma \times BR(qq \to qqH(H \to \tau\tau))} = \frac{\Gamma_W \Gamma_W}{\Gamma_W \Gamma_\tau} = \frac{\Gamma_W}{\Gamma_\tau}$
- Indirect measurement
  - $\frac{\sigma \times BR(WH(H \to \gamma\gamma))}{\sigma \times BR(H \to \gamma\gamma)} = \frac{\Gamma_W \Gamma_\gamma}{\Gamma_g \Gamma_\gamma} \sim \frac{\Gamma_W}{\Gamma_t} * C_{QCD}$
  - $\frac{\sigma \times BR(WH(H \to WW))}{\sigma \times BR(H \to WW^*)} = \frac{\Gamma_W \Gamma_W}{\Gamma_g \Gamma_W} \sim \frac{\Gamma_W}{\Gamma_t} * C_{QCD}$
  - $\frac{\sigma \times BR(ttH(H \to bb))}{\sigma \times BR(ttH(H \to \gamma\gamma))} = \frac{\Gamma_t \Gamma_b}{\Gamma_t \Gamma_\gamma} \sim \frac{\Gamma_b}{\Gamma_W}$
    - * Uncertainties on the ratio arising through different production processes are not included

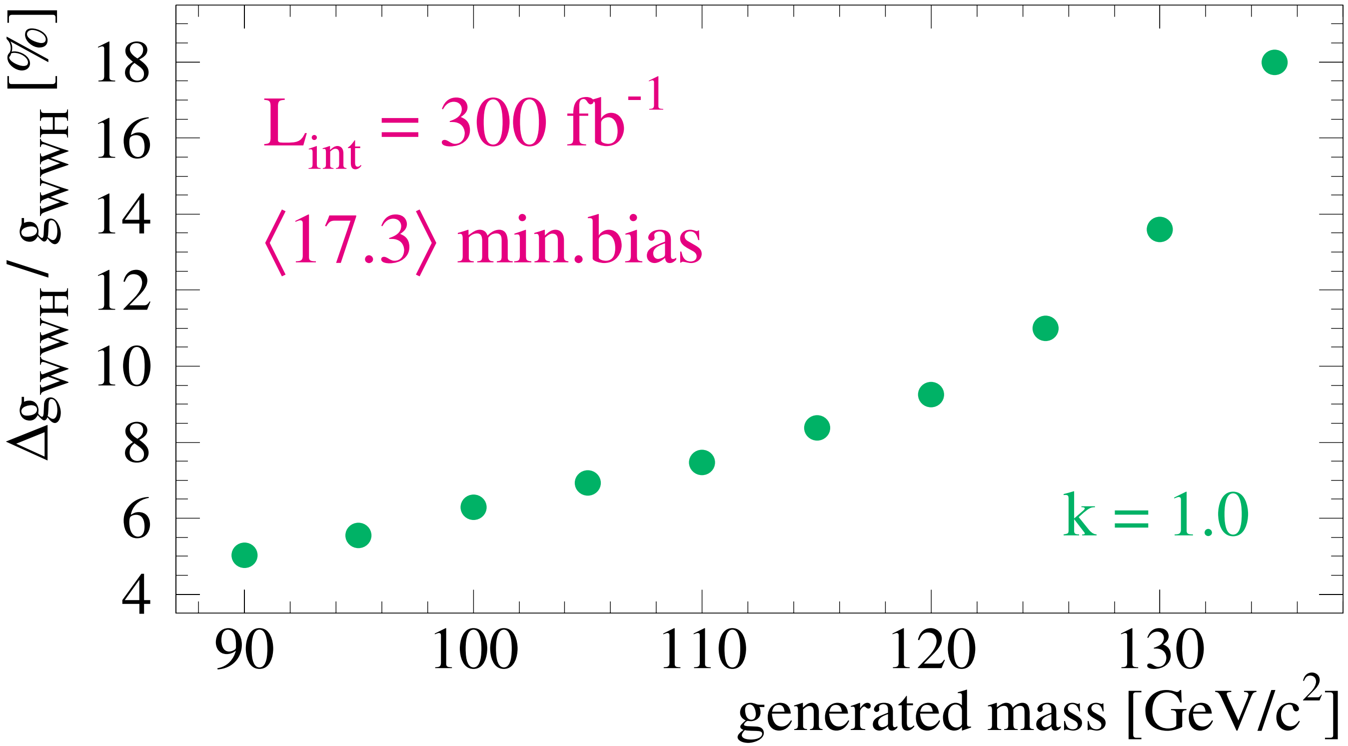
Results for 30 fb^{-1} and 300 fb^{-1} per experiment



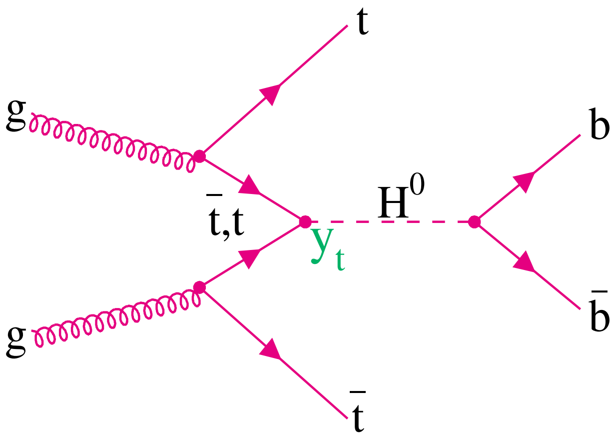
WWH Coupling



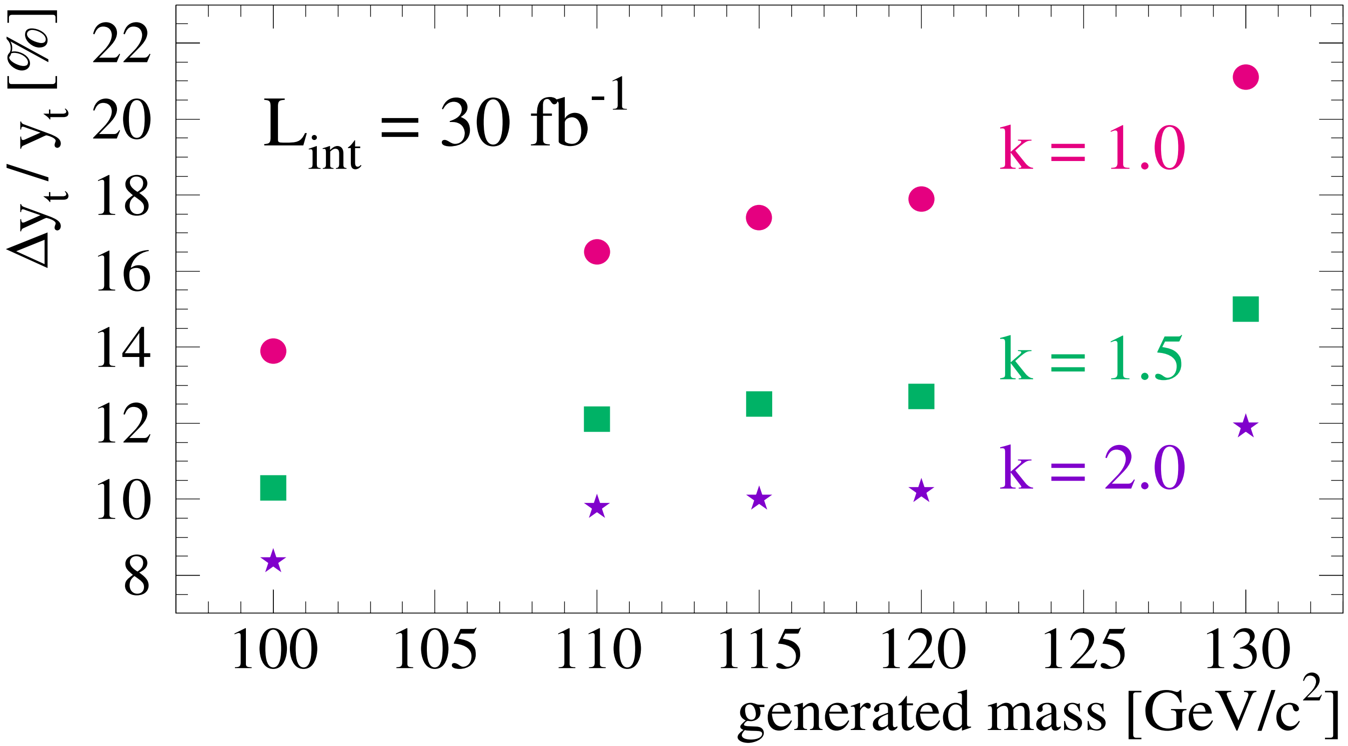
- $g_{WWH} \sim \sqrt{\sigma} \sim \sqrt{N}$
- assume known coupling to $b\bar{b}$



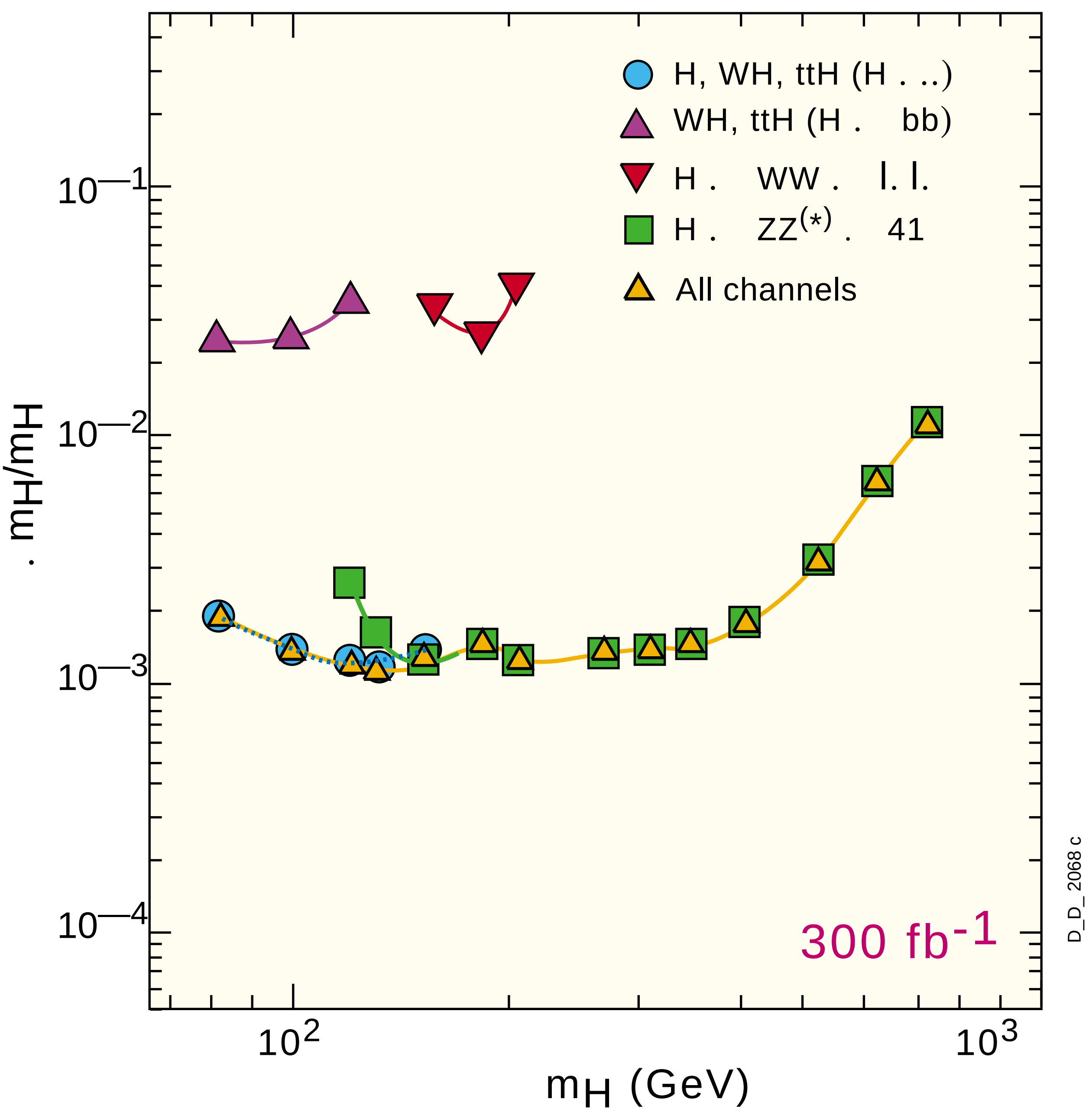
Top Higgs Yukawa Coupling



- $y_t \sim \sqrt{\sigma} \sim \sqrt{N}$
- assume known coupling to $b\bar{b}$



Precision on SM Higgs mass



Limiting factor is knowledge of the absolute energy scale

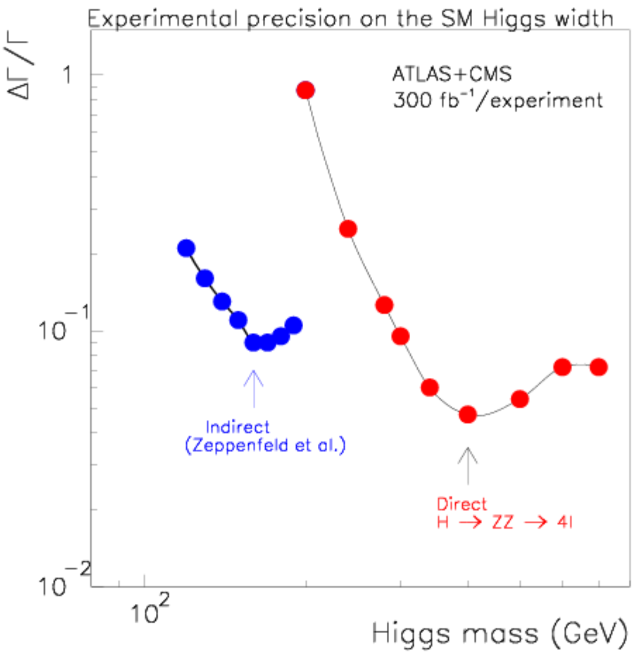
for leptons and photons it is assumed to be known to 0.1% thanks to nearby Z

for jets it is assumed to be 1%

Width

- Direct
  - Mass peak width for m_H > 200 GeV ($\Gamma_H > \Gamma_{exp.}$ in SM)
  - Limited by radiative decays (1.5%)
  - MSSM : possible for $A/H \rightarrow \mu\mu$

- Indirect
  - From rates of qqH in $\gamma\gamma$, $\tau\tau$, WW
  - Assume BR in cc, non-standard < 10%

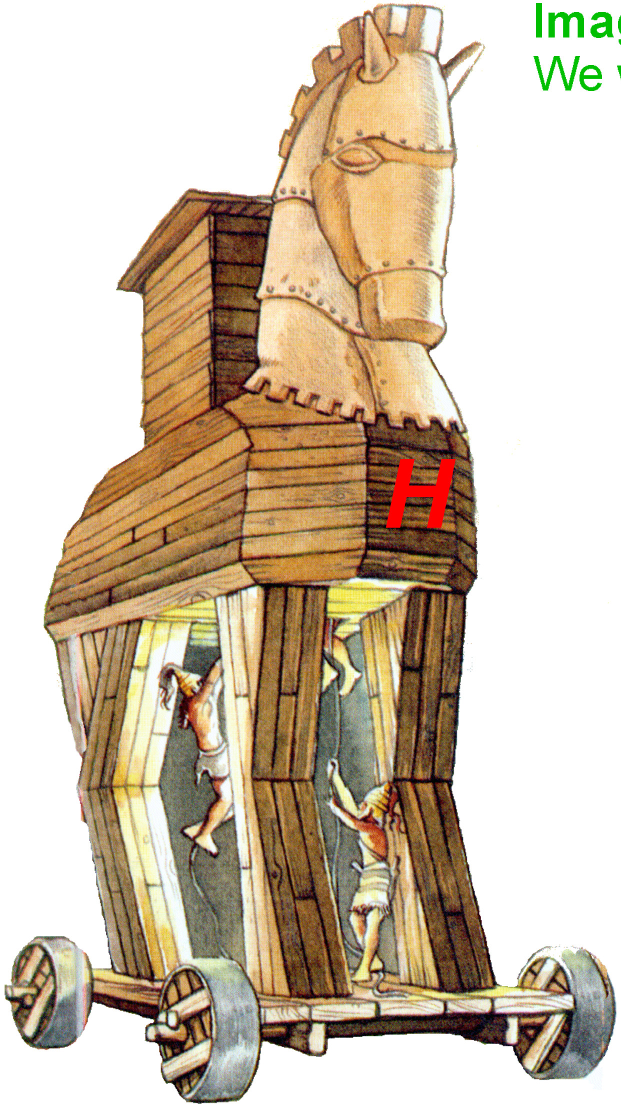


Higgs self-coupling

- for SM $HH \rightarrow WWWW \rightarrow l\nu\ jj\ l\nu\ jj$

  (under study, seems very difficult)

SM higgs — The Trojan Horse



Imagine, that we turn on LHC and we find just SM higgs.
We will behave like Trojans finding the Wooden Horse:

- **We will anounce it to the world.**
- **We will celebrate our great victory.**
- **There will be laurel wreaths for heroes** (Nobel) **and festivities for the crowd,**
- **TV shows and newspaper covers ...**

But this will be the begining of the end ...

We will be left with

- **the Standard Model which works perfectly, but we do not understand why,**
- **the Higgs mechanism which we do not know where it comes from,**
- **nonunified forces, random symmetries, and ~20 arbitrary parameters,**
- **with no hint what is behind,**
- **no idea what to do next ...**