Higgs Physics at CMS

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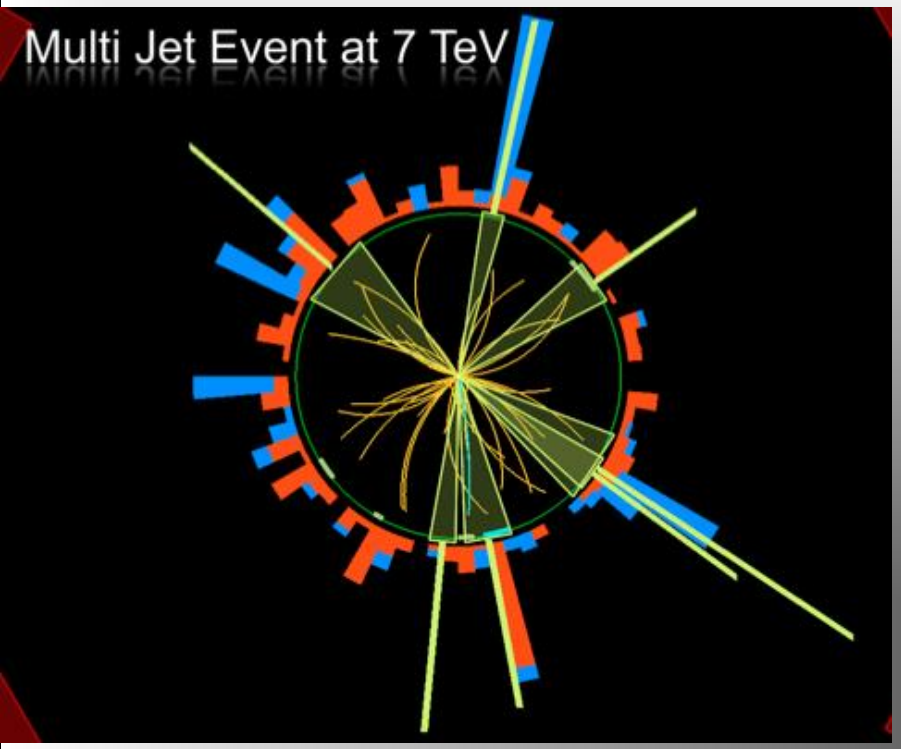
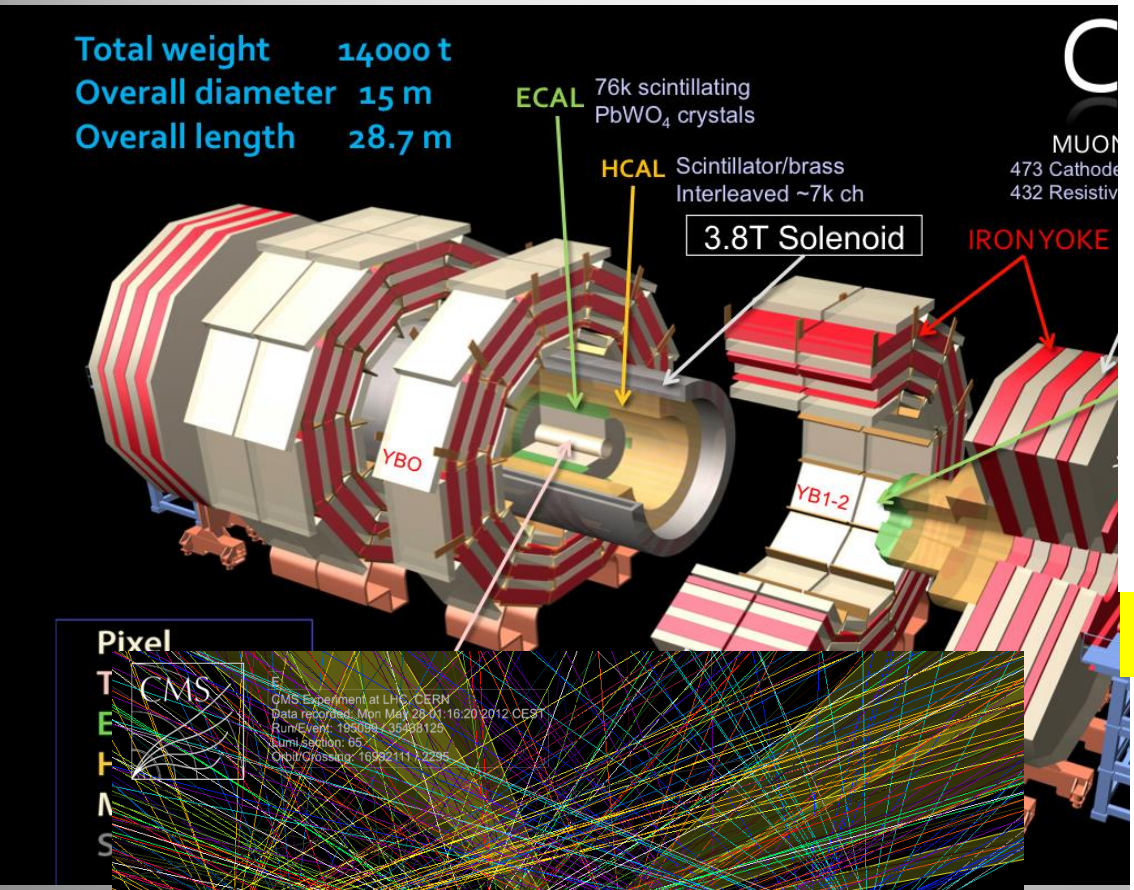


Outline

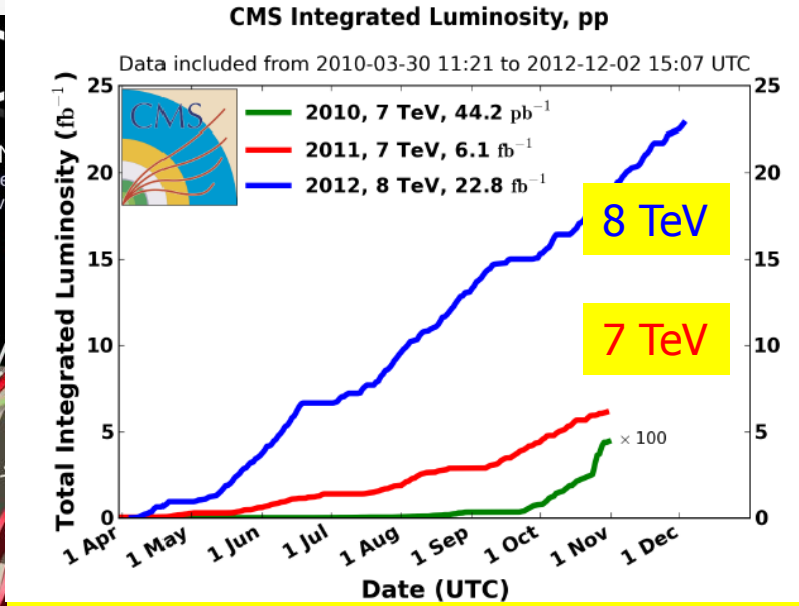
- Introduction & Performance
- Higgs searches
  Overview of the results including updates
- Studies of Higgs properties
- Summary

OR: The year after!!
Melbourne 4th of July

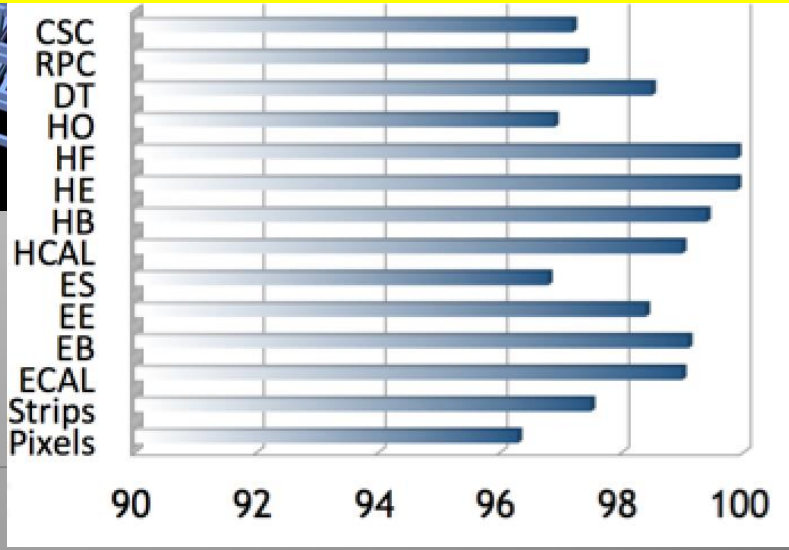
The CMS Detector



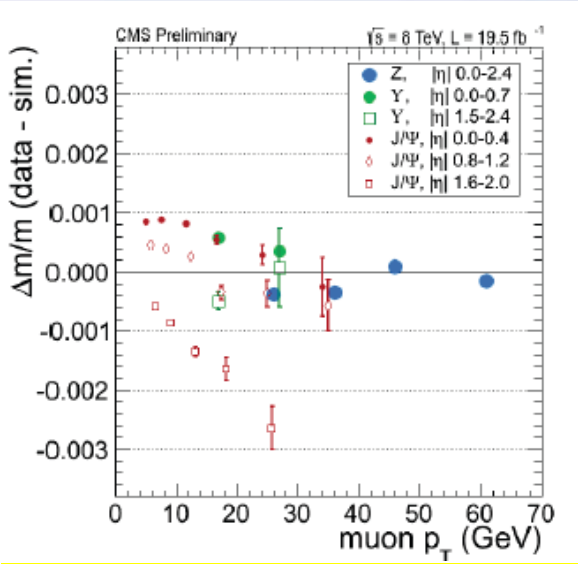
~ 25 events on average per BX



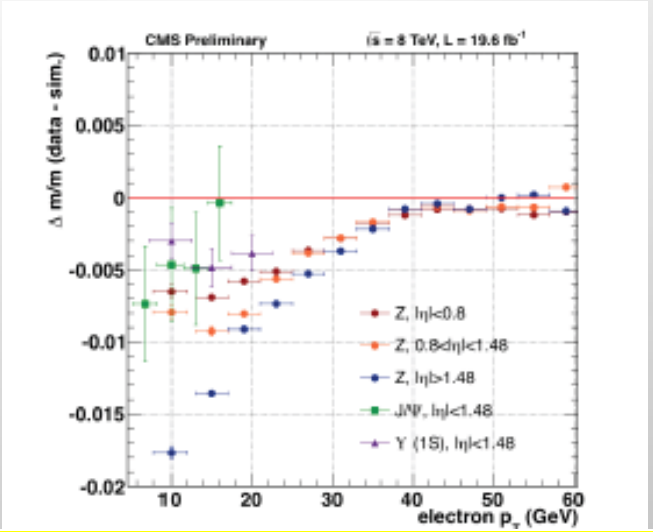
Detector Performance End 2012



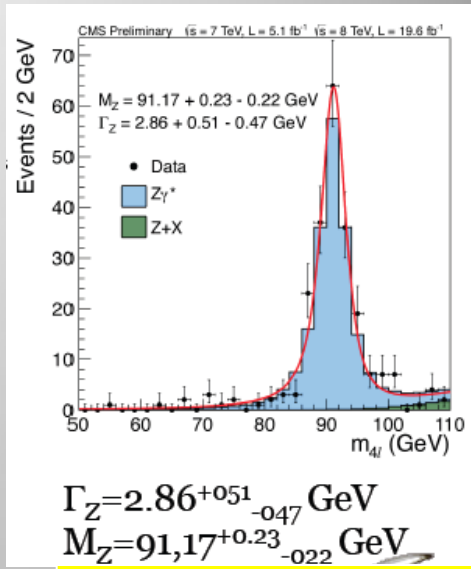
CMS Ready for the Higgs Hunt



Muon momentum scale ~0.1%



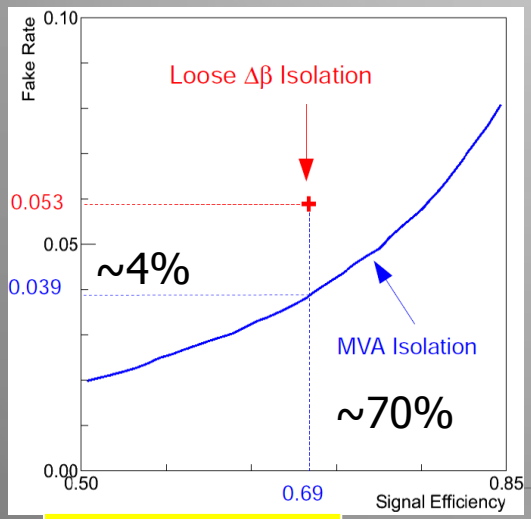
Electron momentum scale ~ 0.2% for p_T>35 GeV, else down to 1.5%



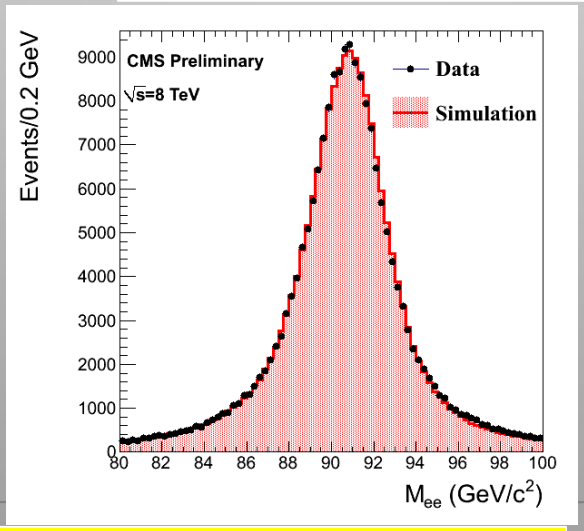
$\Gamma_Z = 2.86^{+051}_{-047}$ GeV

$M_Z = 91{,}17^{+0.23}_{-022}$ GeV

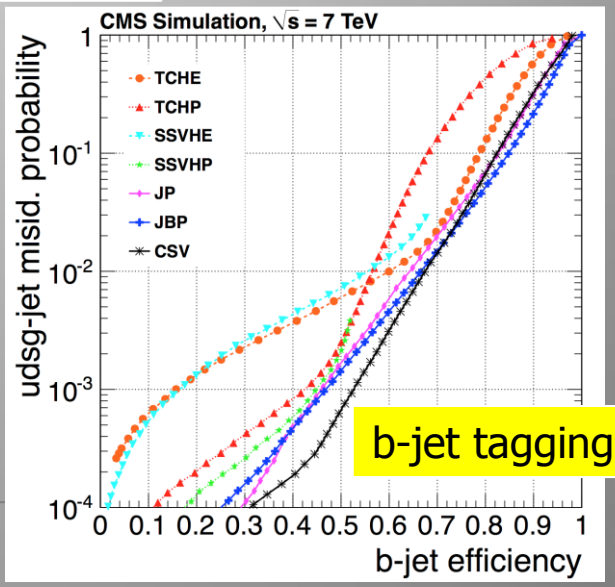
Muons at the Z-peak



Tau efficiency

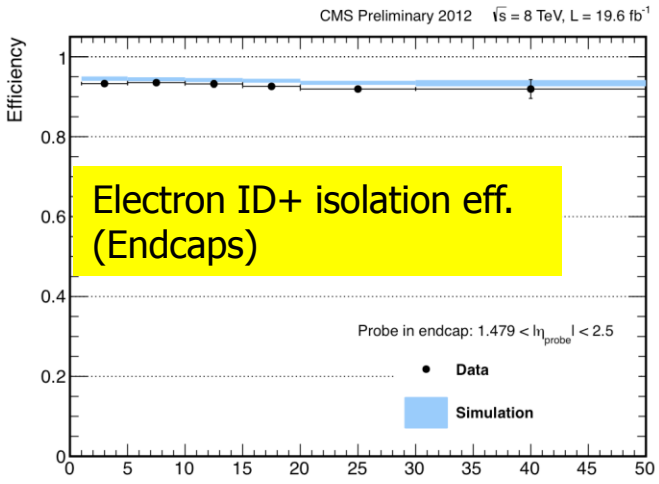


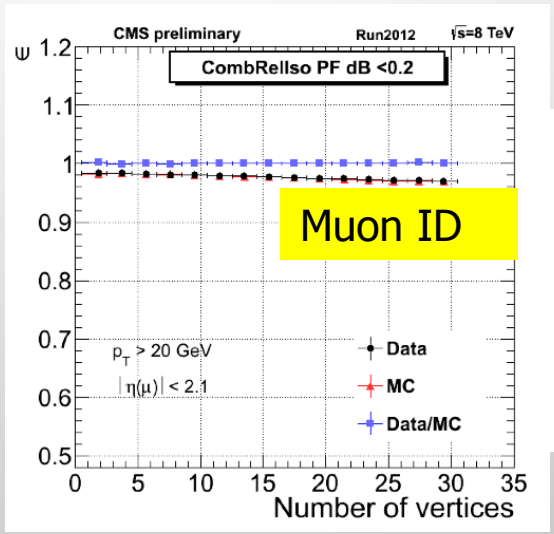
EM-Calo energy scale for γγ



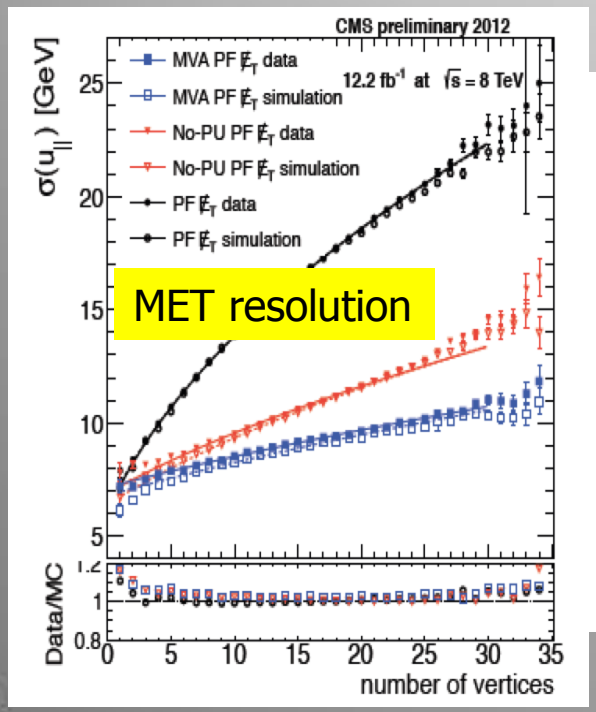
b-jet tagging

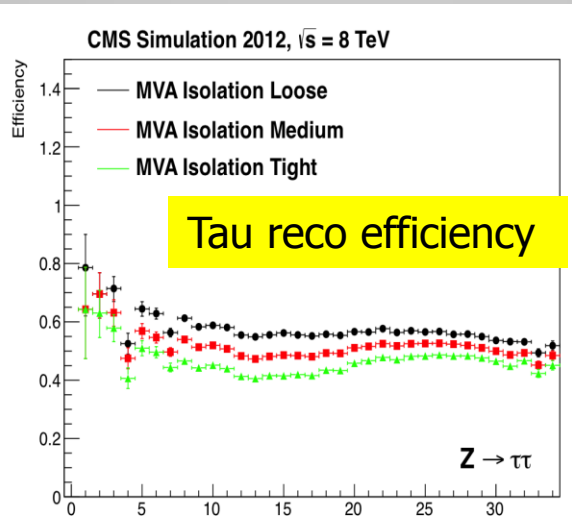
Detector Performance: Pile-Up



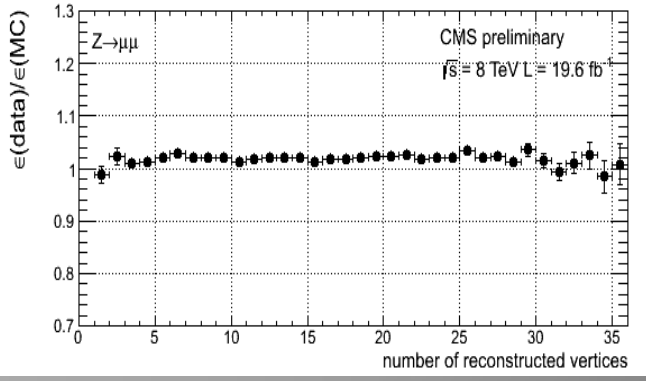


Object performance as a function of the pile-up: ie the number of reconstructed vertices





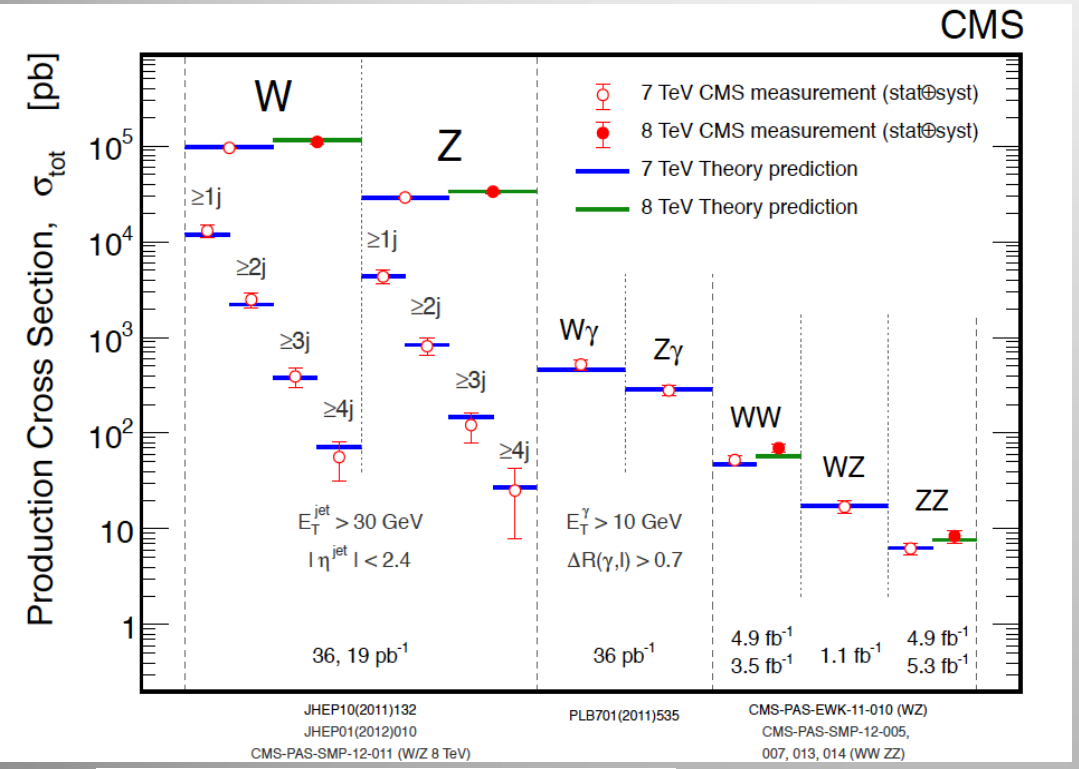
Vertex reco efficiency (for $\gamma\gamma$)



Data/MC ratio using $Z \rightarrow \mu\mu$ with muon tracks removed

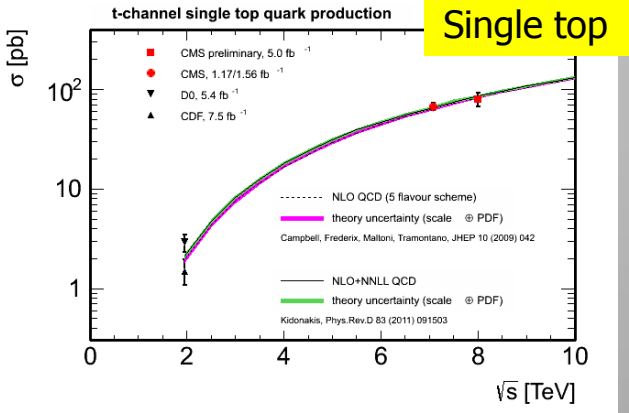
Standard Model Measurements

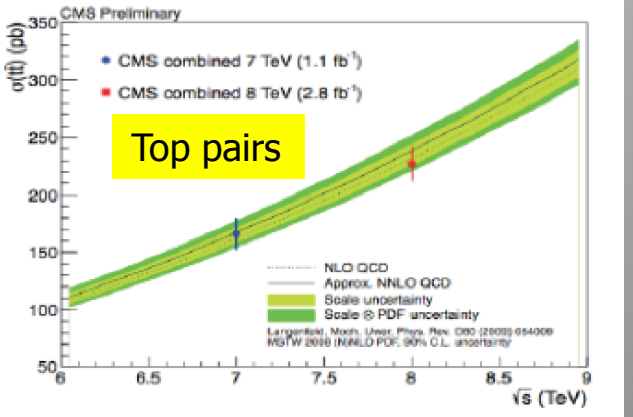
Electroweak Measurements



More later during LP2013

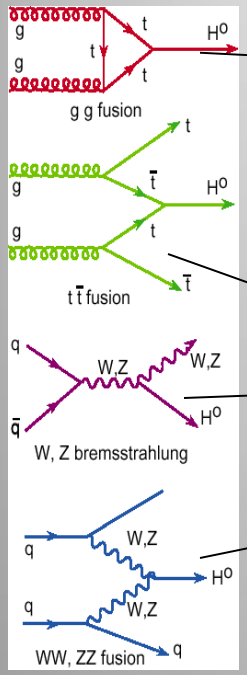
Top Quark Cross Sections

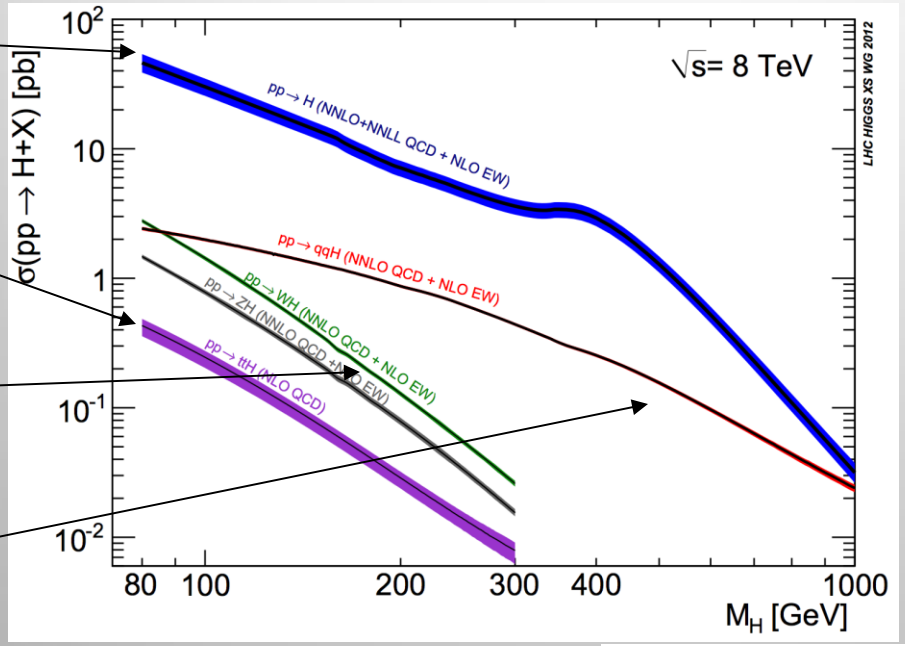




Good understanding of the detector + accurate theory predictions
→Precise measurements of the SM processes in a large range
→Good knowledge of the backgrounds to the Higgs analyses

Higgs Production & Decay

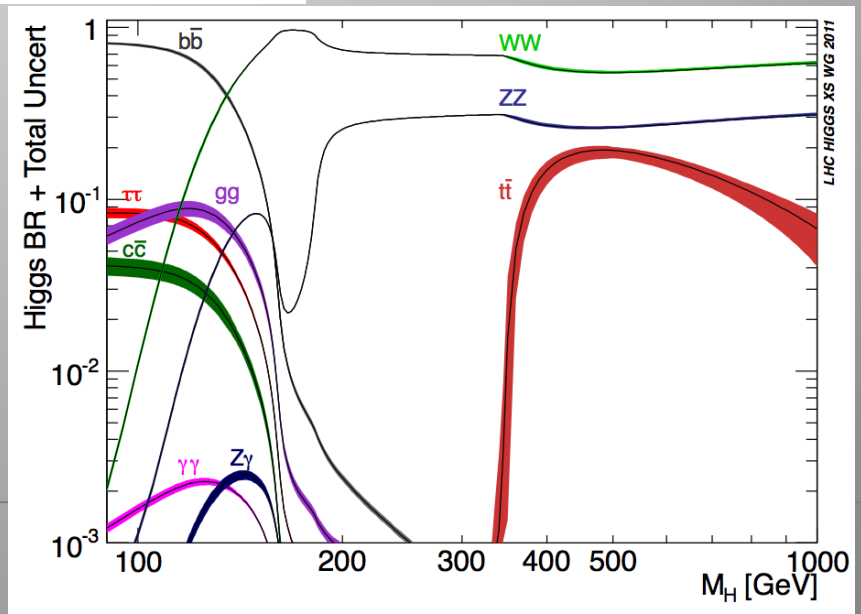




Processes
- Gluon fusion
- Vector Boson Fusion
- W/Z associated prod.
- Top associated prod.

Numbers taken from the LHC Higgs Cross Section WG

See yellow reports:
YR1: Inclusive cross sections
YR2: Differential cross sections
YR3: Properties (to appear)



Higgs Hunting in CMS

Processes/decays studied:

Results released In progress

	untagged	VBF	VH	ttH
H-> gamgam				
H-> ZZ				
H->WW				
H-> bb				
H-> tau tau				
H-> Zgamma				
H-> mumu				
H-> invisible				

$\Gamma_{BSM} = 0$

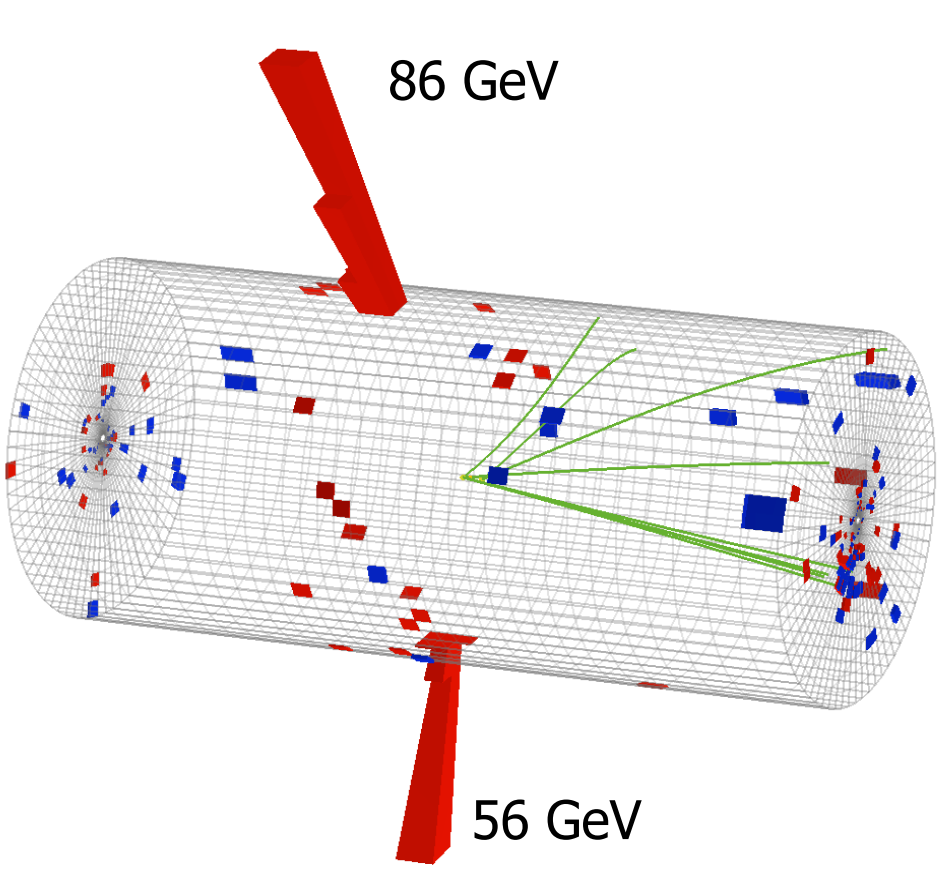
+ more exotic channe

Main decay channel characteristics:

Channel	m_H range (GeV/c^2)	Data used 7+8 TeV (fb^{-1})	m_H resolution
H -> $\gamma\gamma$	110-150	5.1+19.6	1-2%
H -> tautau	110-145	4.9+19.6	15%
H -> bb	110-135	5.0+19.0	10%
H -> WW -> lnulnu	110-600	4.9+19.5	20%
H -> ZZ -> 4l	110-1000	5.1+19.6	1-2%

Higgs Decay into Bosons

The Decay H→ γγ



CMS-PAS-HIG-13-001

Analysis

- Two high momentum photons
- Low mass Higgs is narrow
- Two photon resolution is excellent
- Looking for a narrow peak
- Large irreducible background from direct two photons
- Smaller fake photon background

Key analysis features

- Energy resolution (calibration)
- Fake photon rejection
- Optimize use of kinematics

The Decay H→ γγ

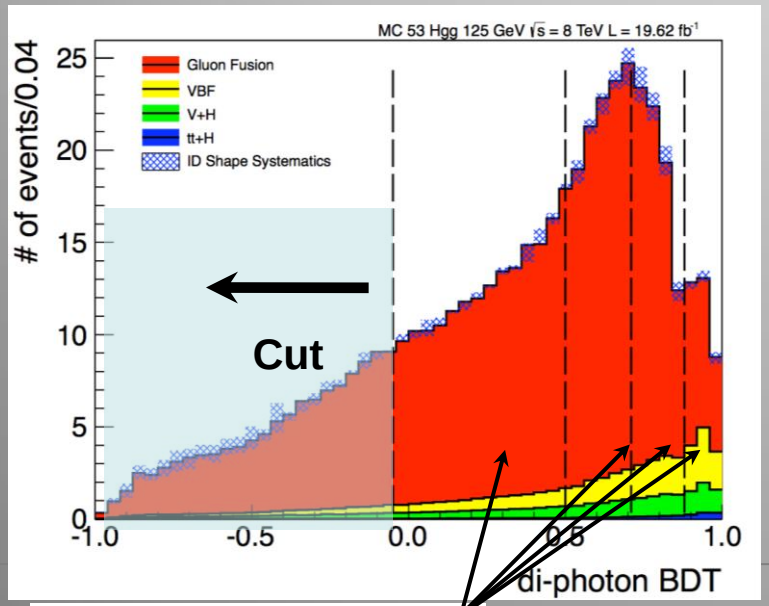
- Two inclusive analyses:
  - MVA: photons selected with an MVA. Variable in the MVA: photon kinematics, photon ID MVA score (shower shape, isolation), di-photon mass resolution. 4 MVA categories with different S/B

PRIMARY

  - Cut-based: photons selected with cuts. 4 categories based on: γ in Barrel/Endcap, (un)converted γ. Each category has different mass resolution and S/B

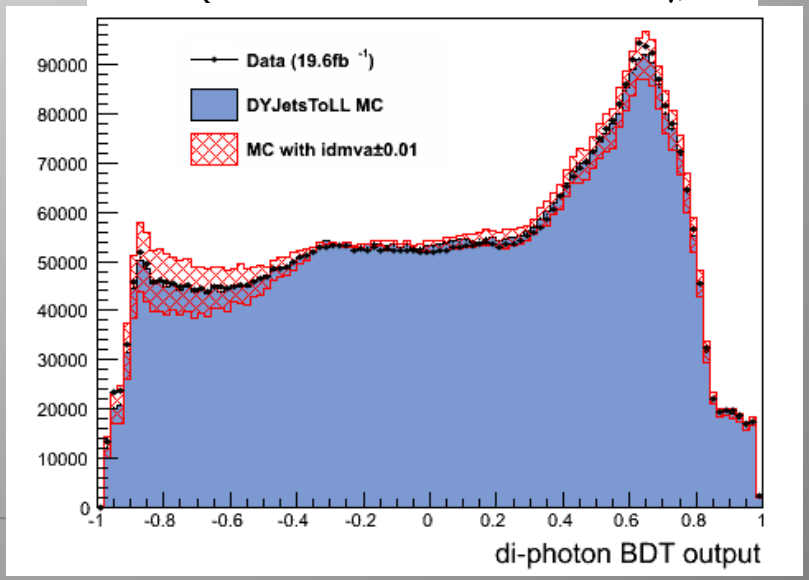
CROSS-CHECK

- 3 VH channels (e, μ and MET tag) + VBF (2 dijet categories)



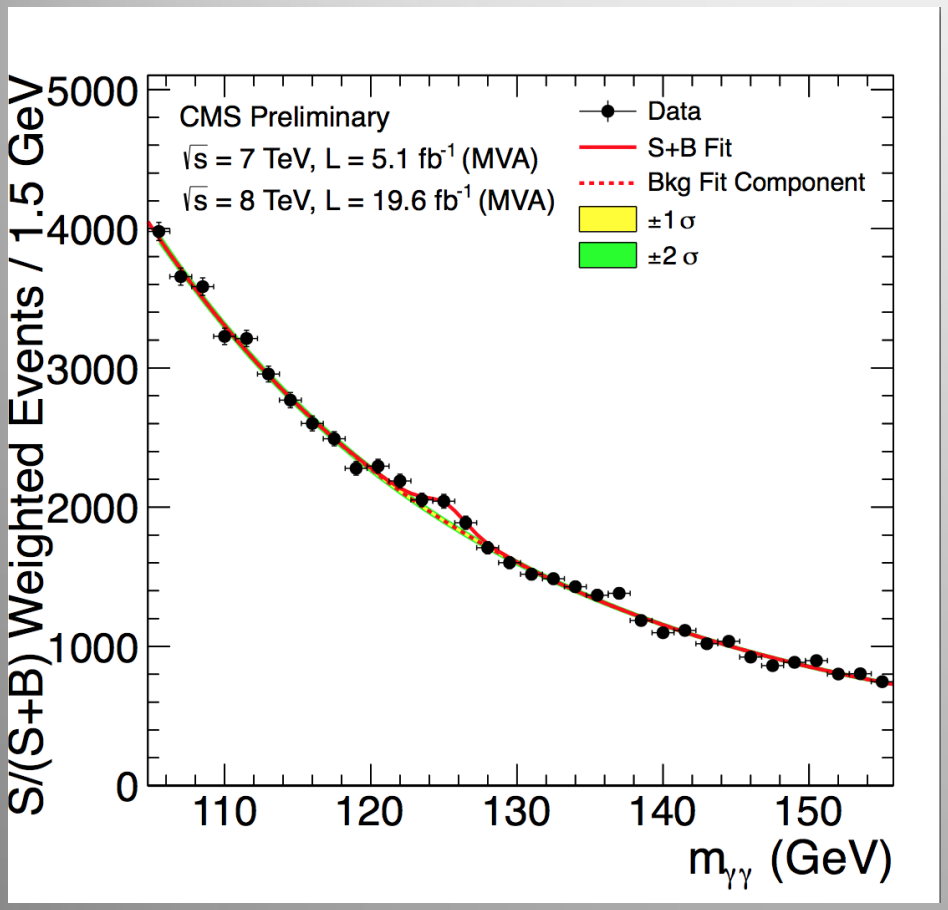
MVA Event categories

Output of the MVA validated using Z→ee (where e are reconstructed as γ)

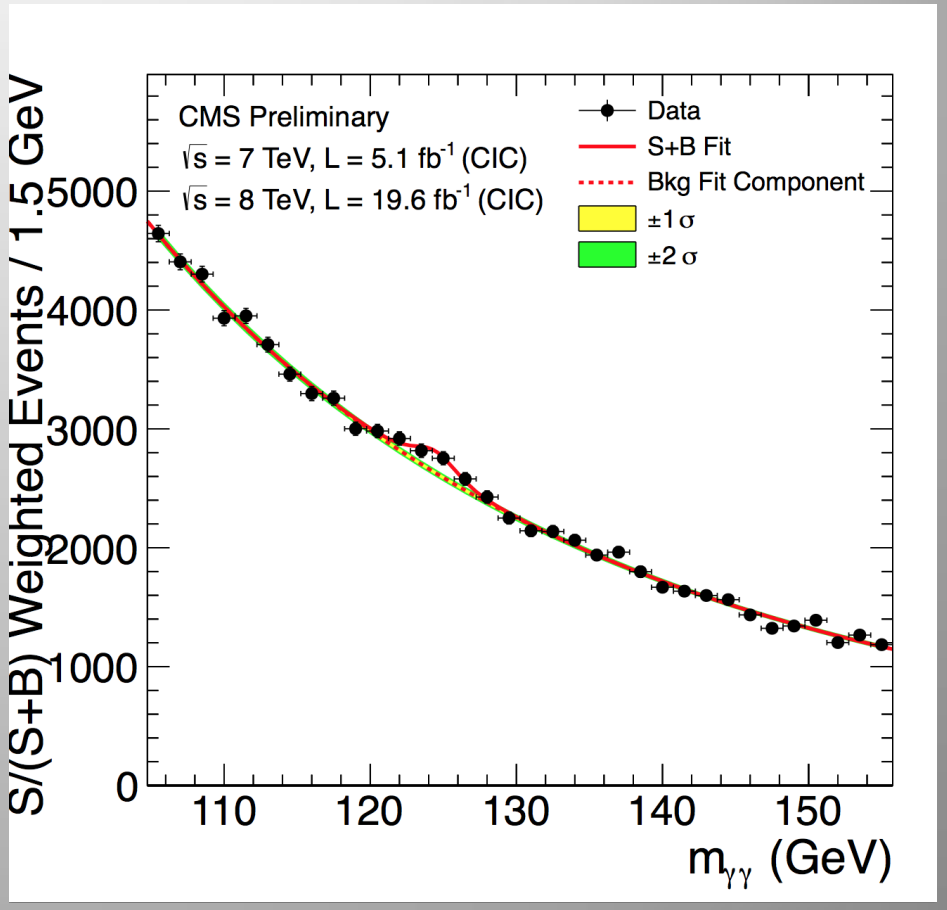


The Decay H→ γγ

MVA mass-factorized



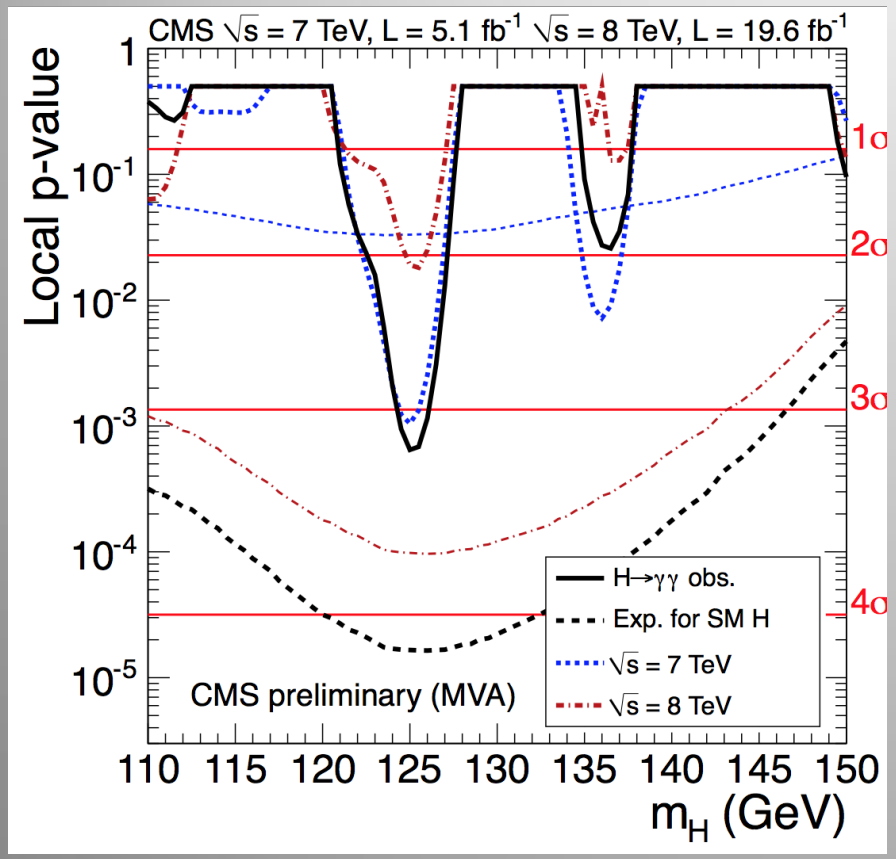
Cut-based



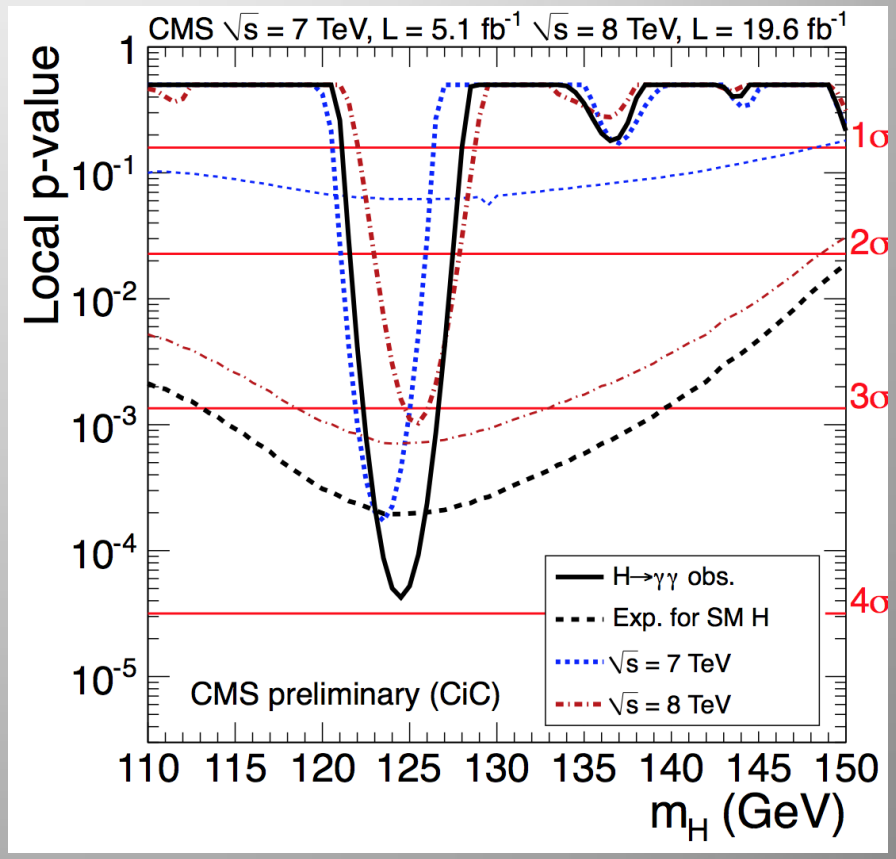
Each event category is weighted by its S/(S+B) only for visualization purposes

The Decay H→ γγ

MVA mass-factorized

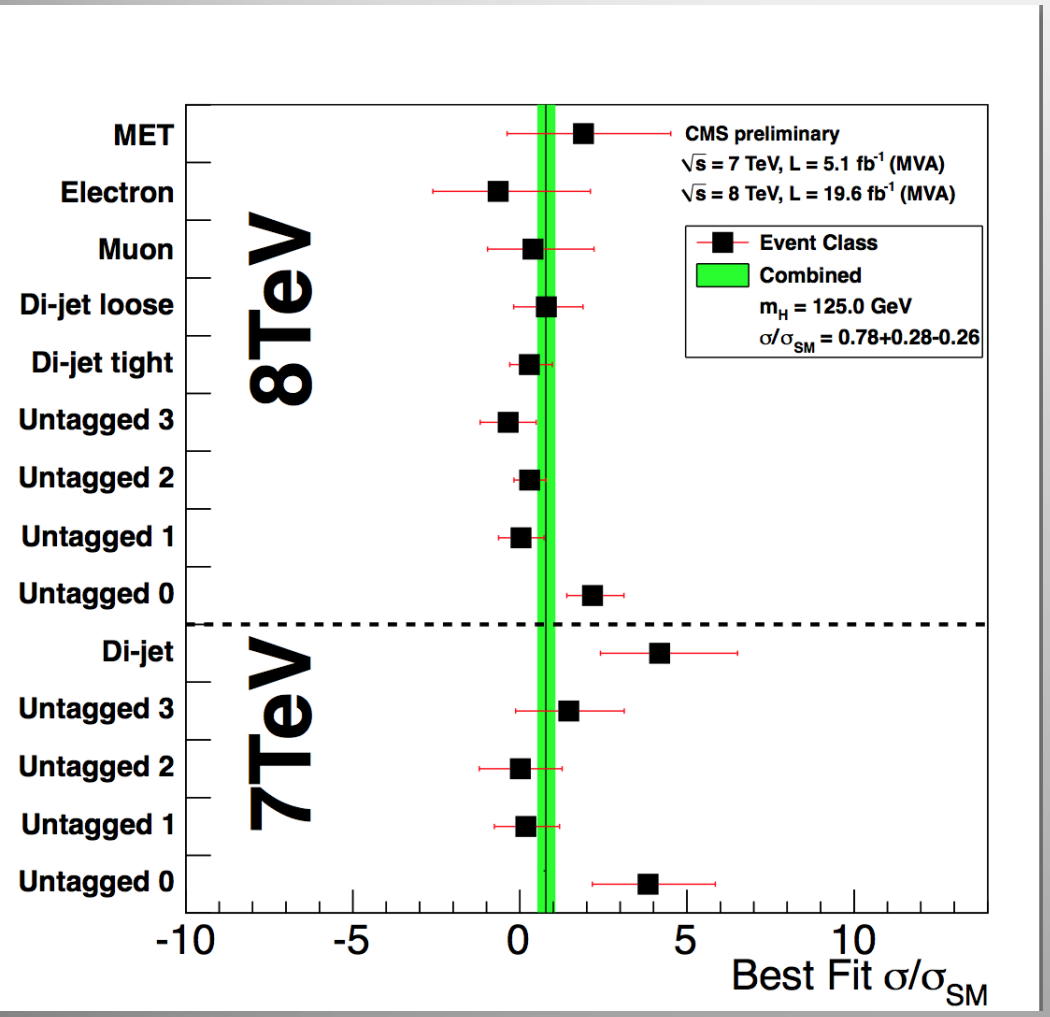


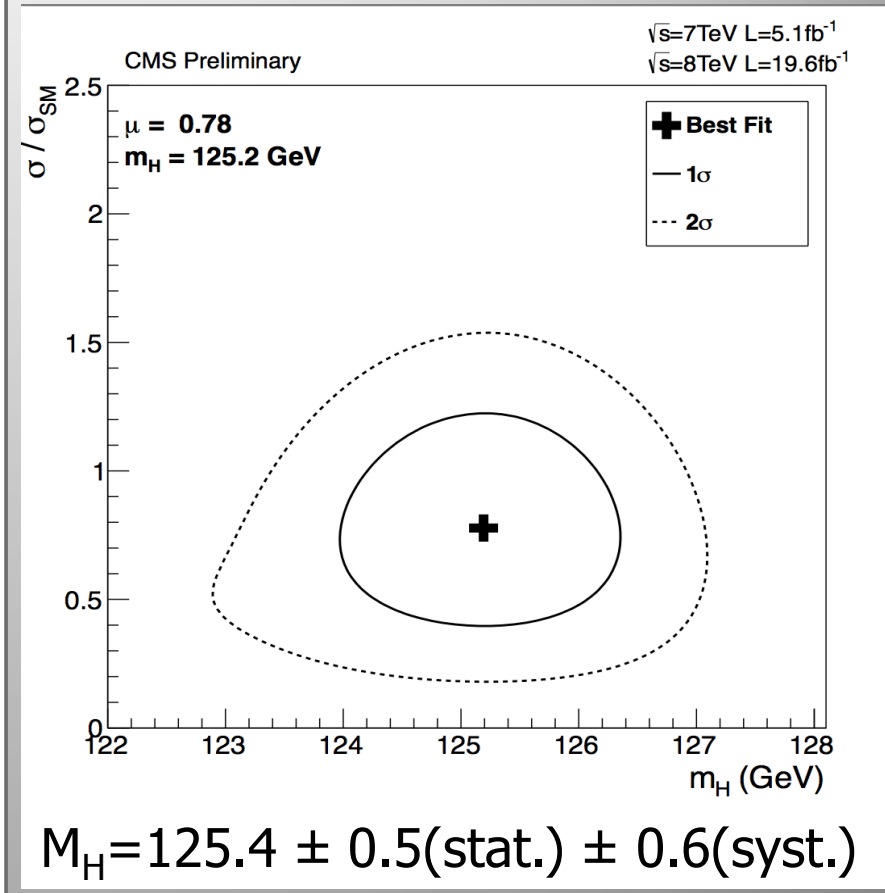
Cut-based



The Decay H→ γγ

MVA mass-factorized

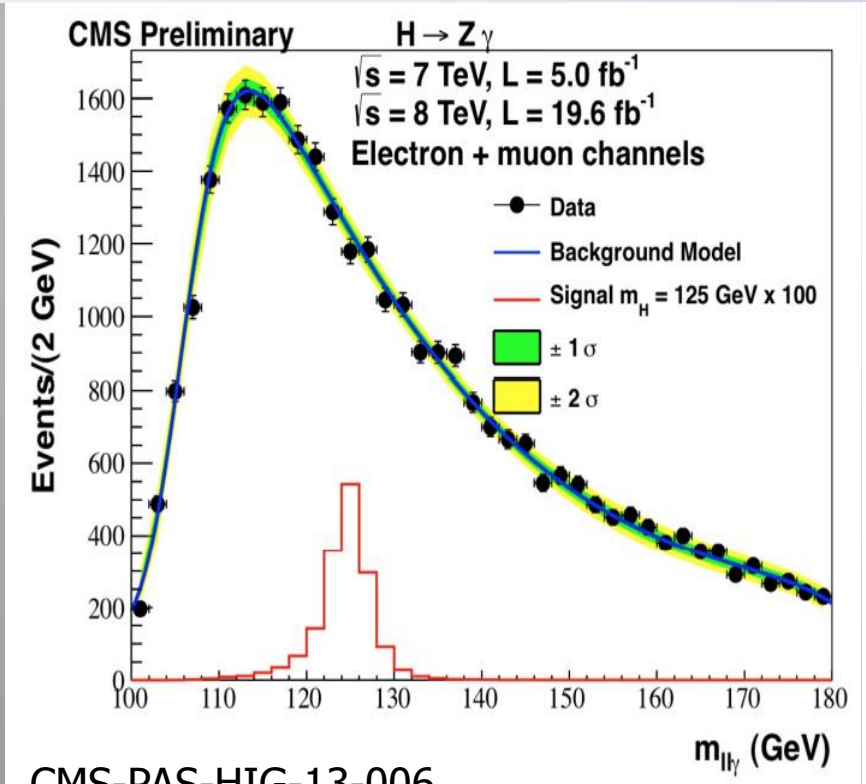




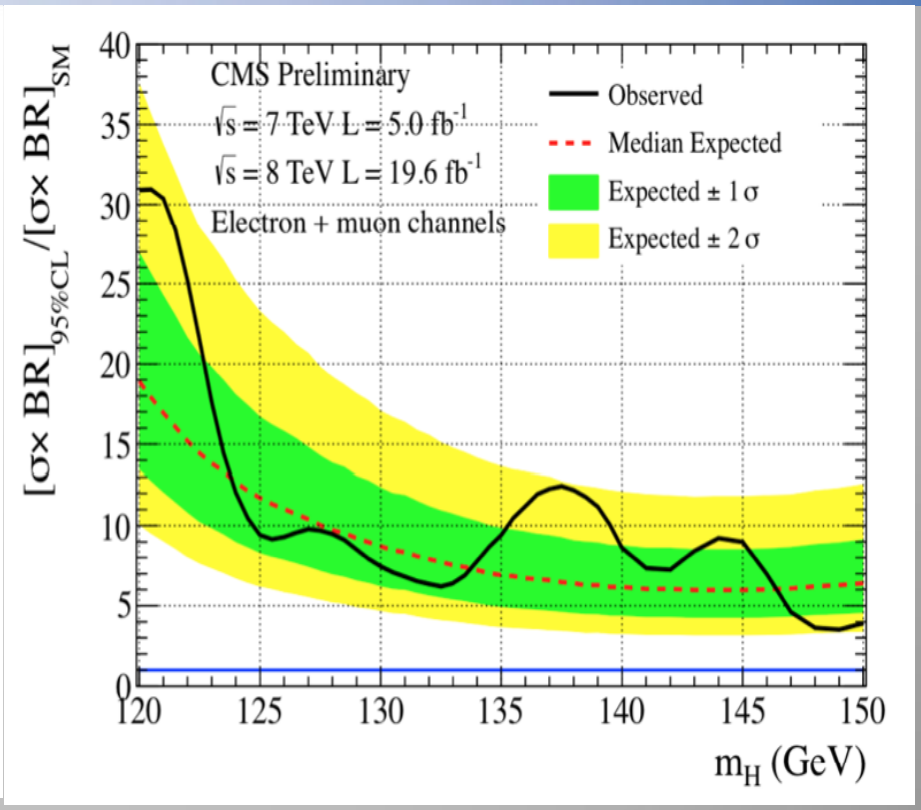
$M_H = 125.4 \pm 0.5(\text{stat.}) \pm 0.6(\text{syst.})$

7+8 TeV: σ/σ_{SM} for a mass of 125.0 GeV = $0.78\ ^{+0.28}_{-0.26}$

The Decay H→ Zγ



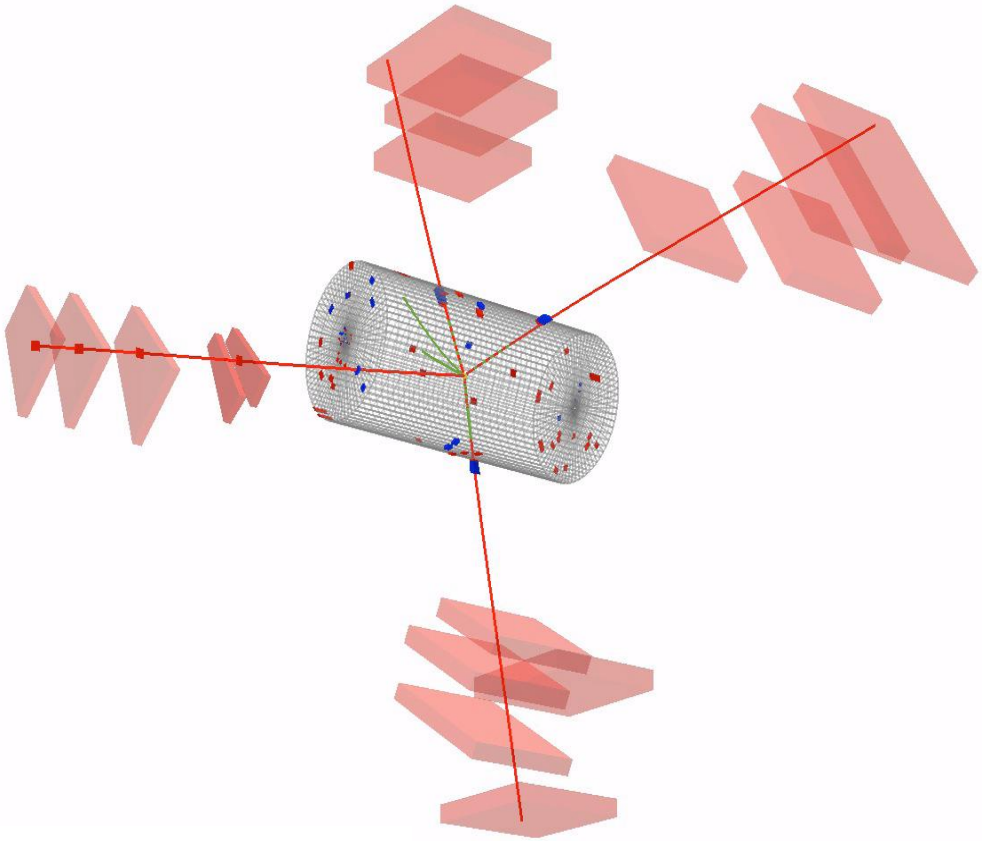
CMS-PAS-HIG-13-006



- Z decays into 2 charged leptons. The BR (H → Z γ) is comparable to BR(H → γγ) , but BR (Z → ll) reduces sensitivity (factor 15)
- Search for a narrow llγ peak on top of a falling background, as for H → γγ
- No significant excess seen over the entire search region

In certain models this channel could be largely enhanced

The Decay H → ZZ → 4l



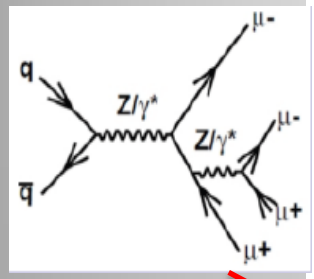
CMS-PAS-HIG-13-002

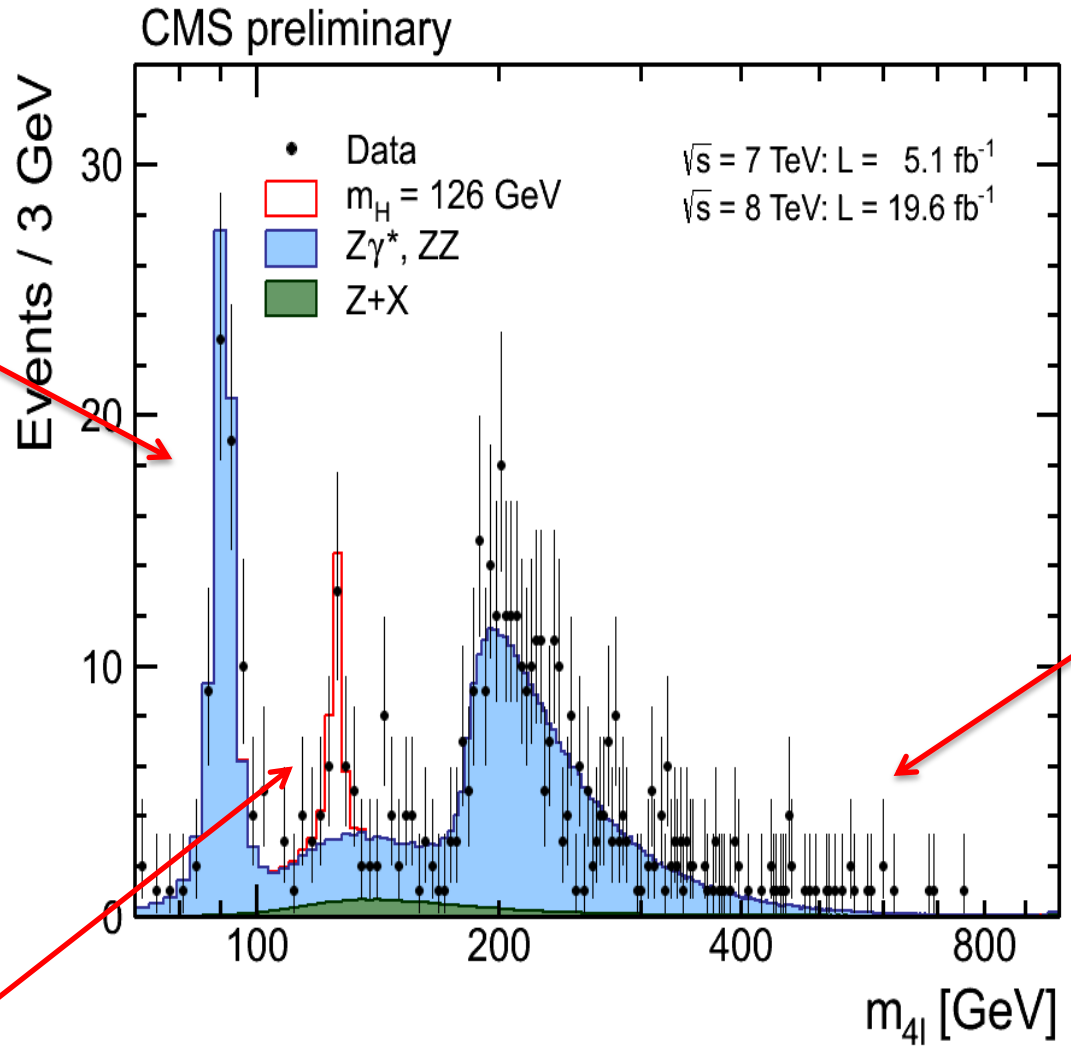
Analysis

- 4 isolated high p_T leptons consistent with Z decays from same vertex
- Use a di-jet tagged and untagged category, and kinematics
- Clear mass peak
- Little background, main comes from non-resonant ZZ production, also Zbb and top (2l2ν2b), fakes

Analysis procedure rather stable since ICHEP2012

The Decay H → ZZ → 4l





Very good control of the dominant ZZ background

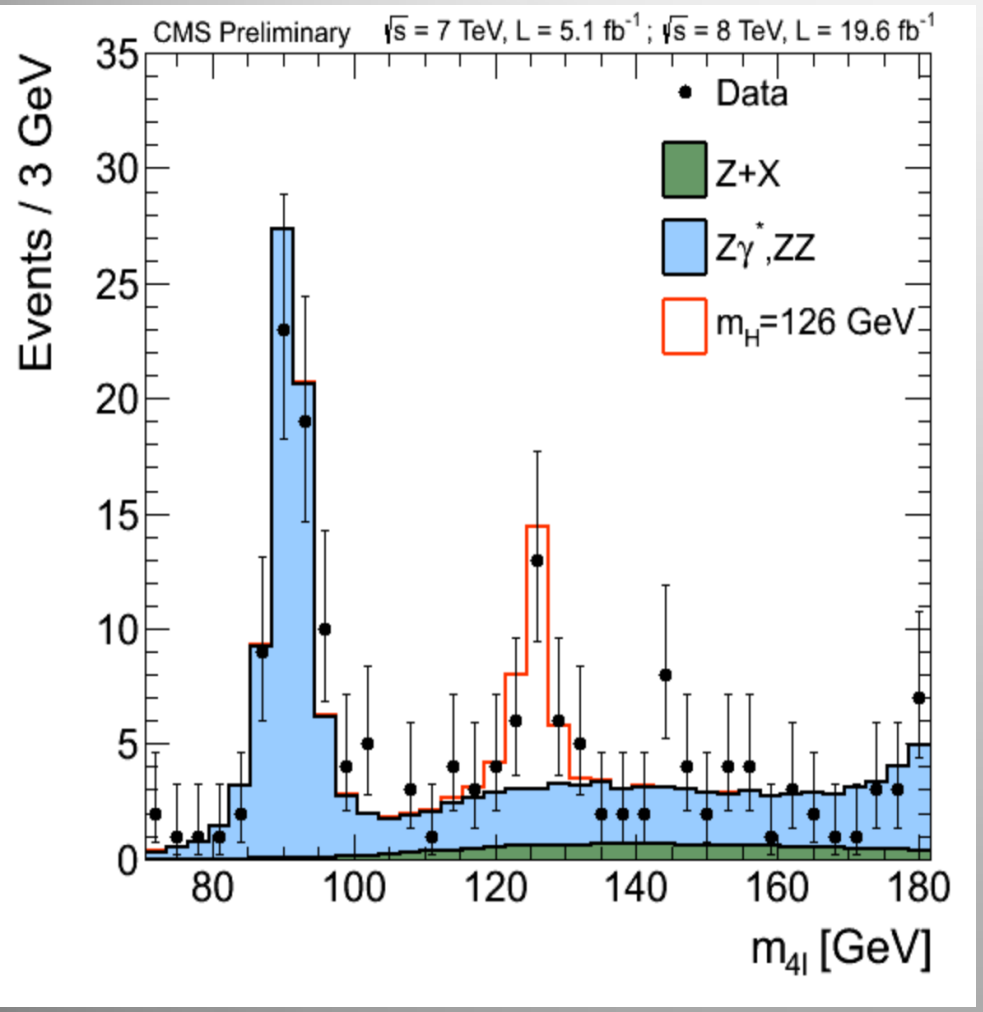
M(4l)>160 GeV
Data 380 evts
MC 364.5 evts

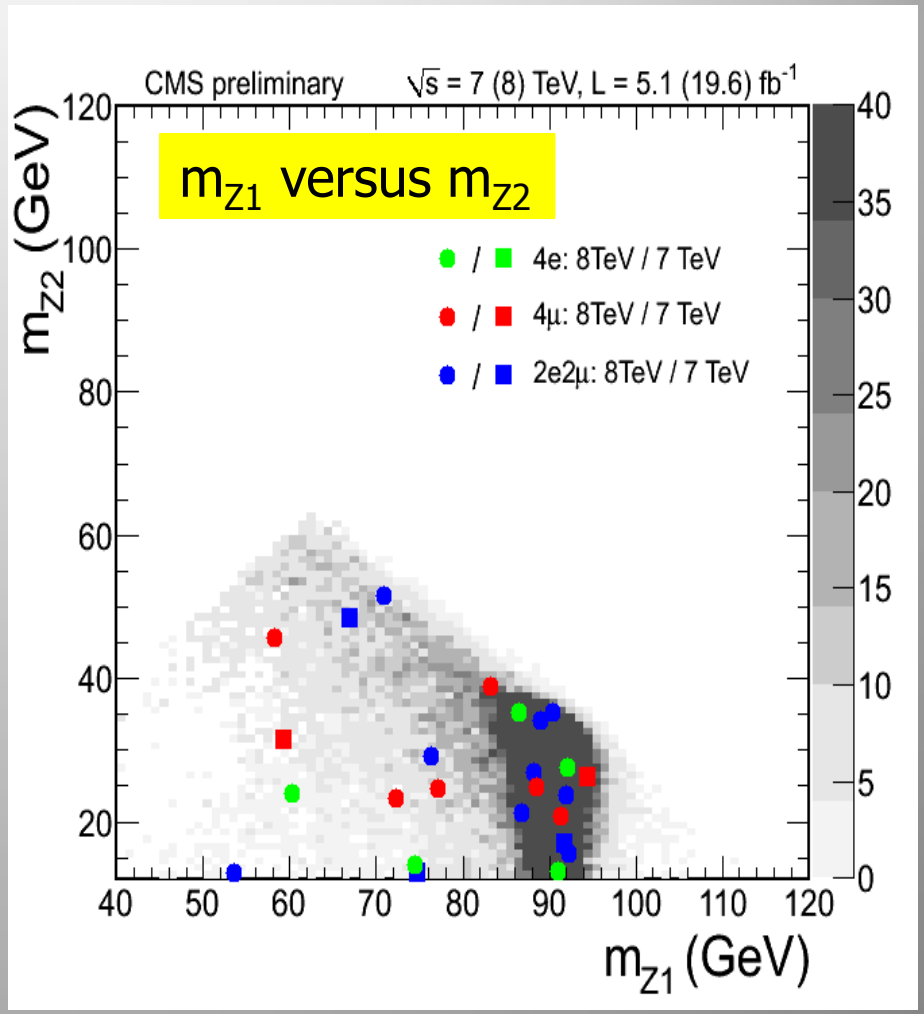
Clean signal peak at ~126 GeV

$\sigma(pp \rightarrow ZZ, 8TeV) = 8.4 \pm 1.0\ (stat.) \pm 0.7\ (syst.) \pm 0.4(lum.)$ pb

$\sigma_{SM}(th) = 7.8 \pm 0.6$ pb

The Decay H → ZZ → 4l



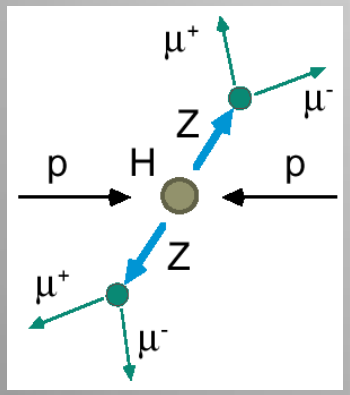


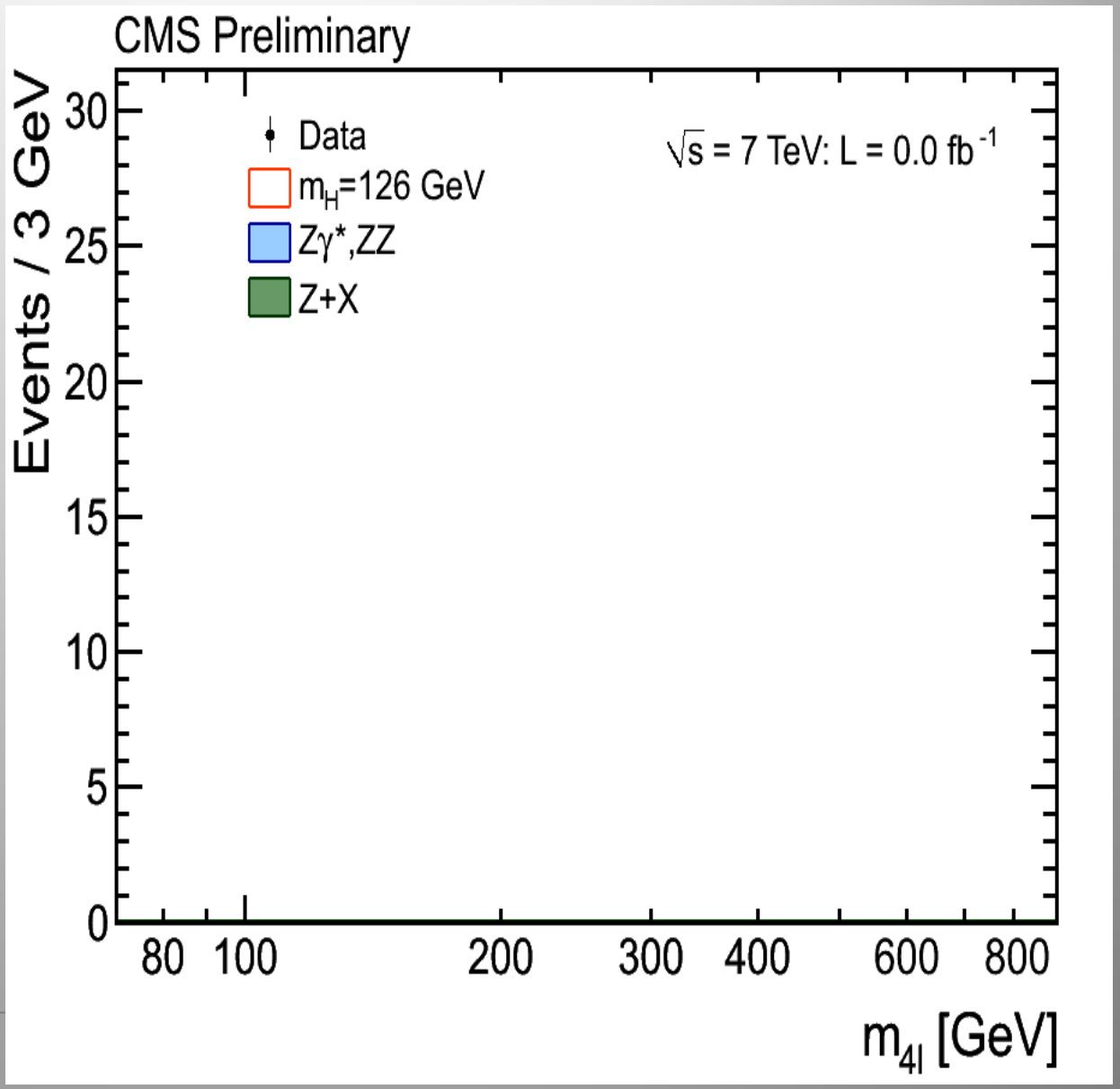
121.5 < M(4l) < 130.5 GeV

The Birth of a Particle

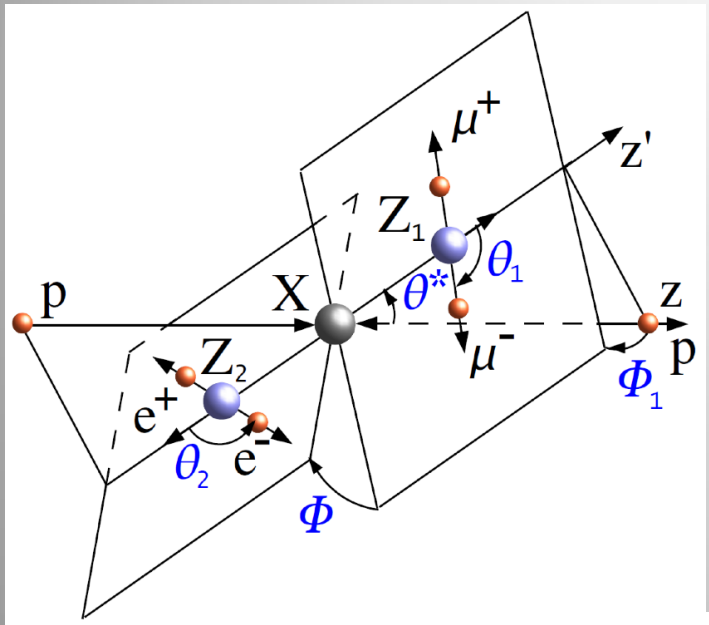
"History" of the data accumulation during the last two years

ZZ with Z→ee or μμ





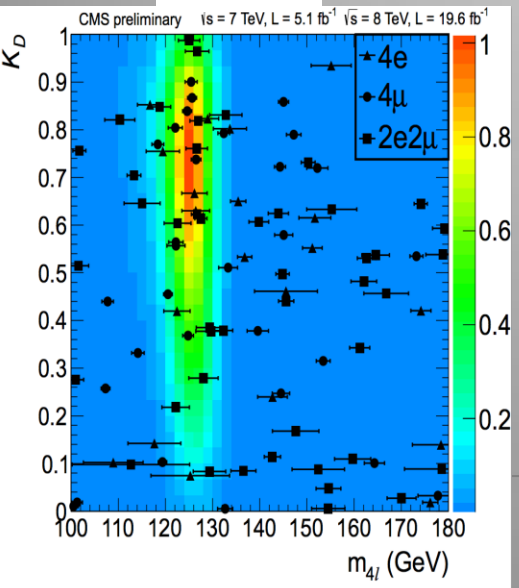
The Decay H → ZZ → 4l



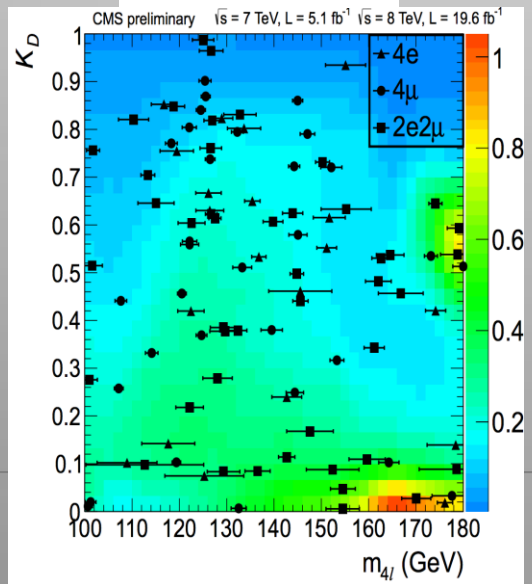
Matrix **E**lement **L**ikelihood **A**nalysis:
uses kinematic inputs to build a kinematic discriminant (K_D) for signal to background discrimination using $\{m_1, m_2, \theta_1, \theta_2, \theta^*, \Phi, \Phi_1\}$

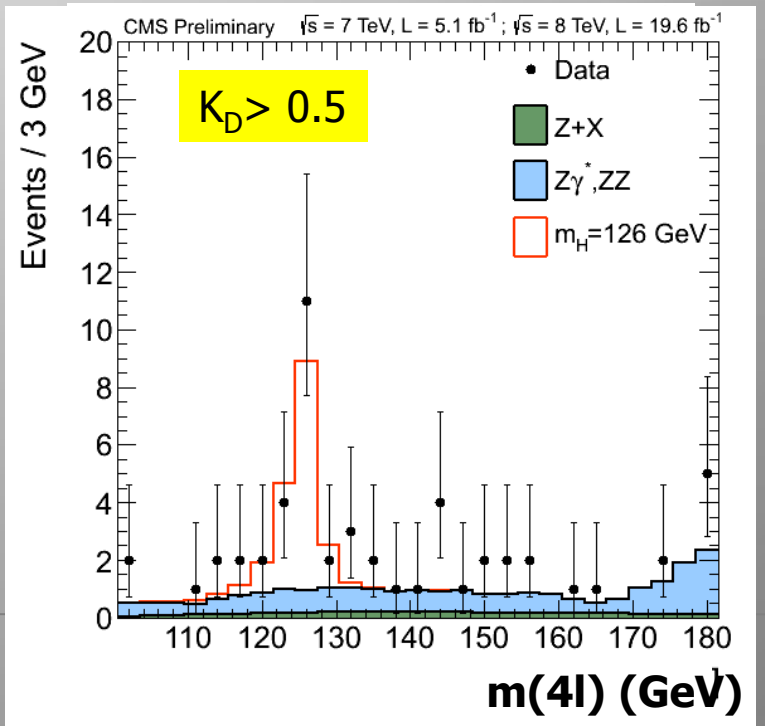
$$\mathrm{MELA} = \left[1 + \frac{\mathcal{P}_{\mathrm{bkg}}(m_1, m_2, \theta_1, \theta_2, \Phi, \theta^*, \Phi_1 | m_{4\ell})}{\mathcal{P}_{\mathrm{sig}}(m_1, m_2, \theta_1, \theta_2, \Phi, \theta^*, \Phi_1 | m_{4\ell})}\right]^{-1}$$

SIGNAL

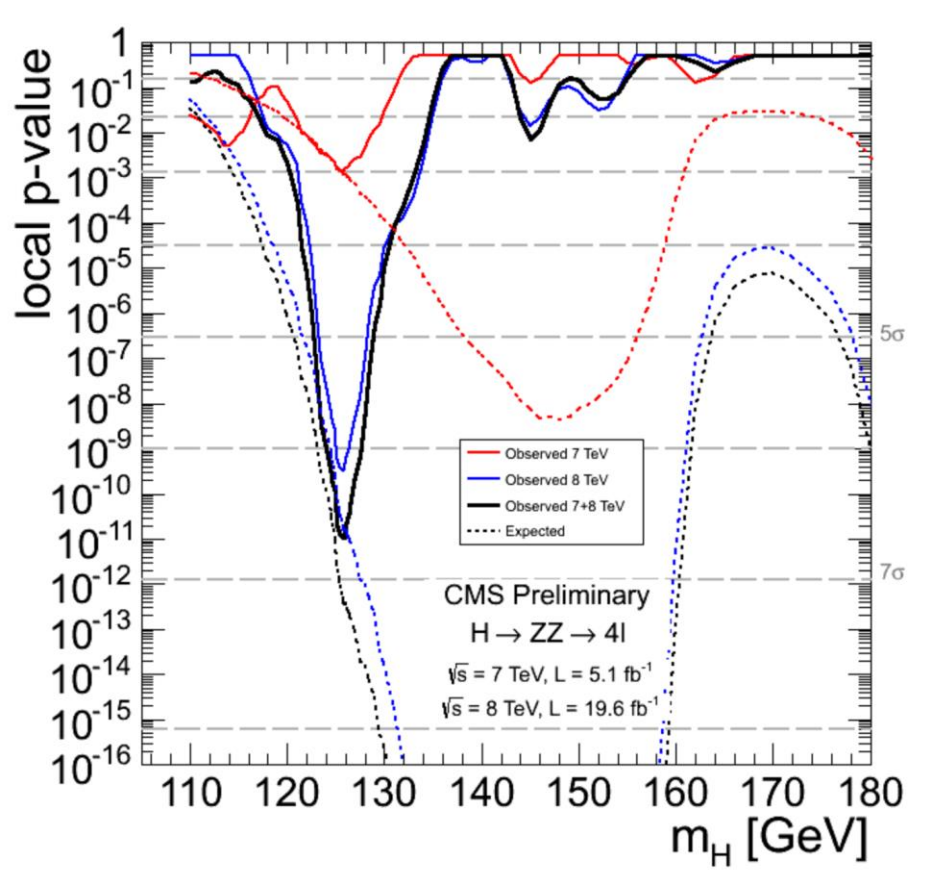


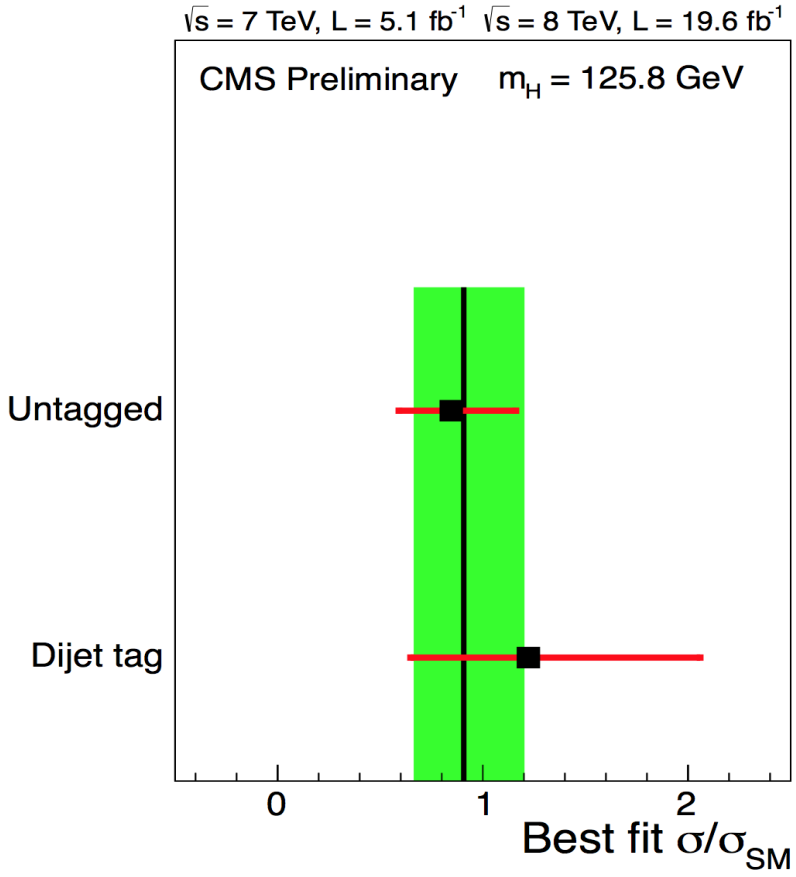
BACKGROUND





The Decay H → ZZ → 4l





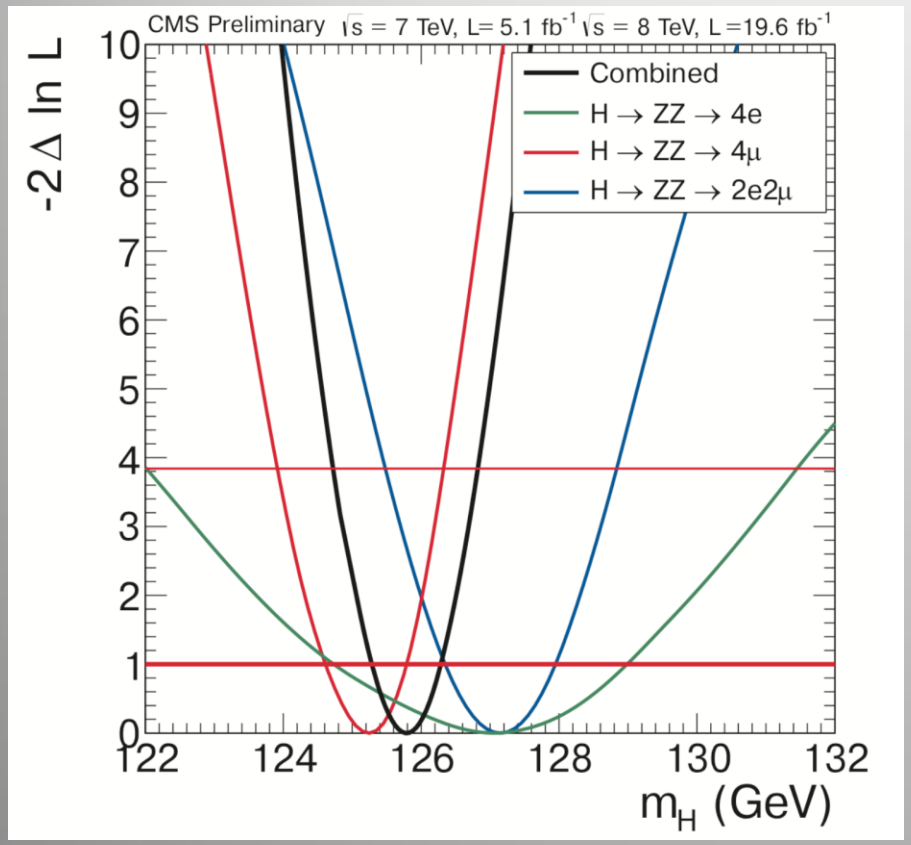
p-value: Expected: 7.1σ
Observed: 6.7σ

σ/σ_{SM} at 125.7 GeV = 0.92 ± 0.28

Significance is well over 6 standard deviations in this channel

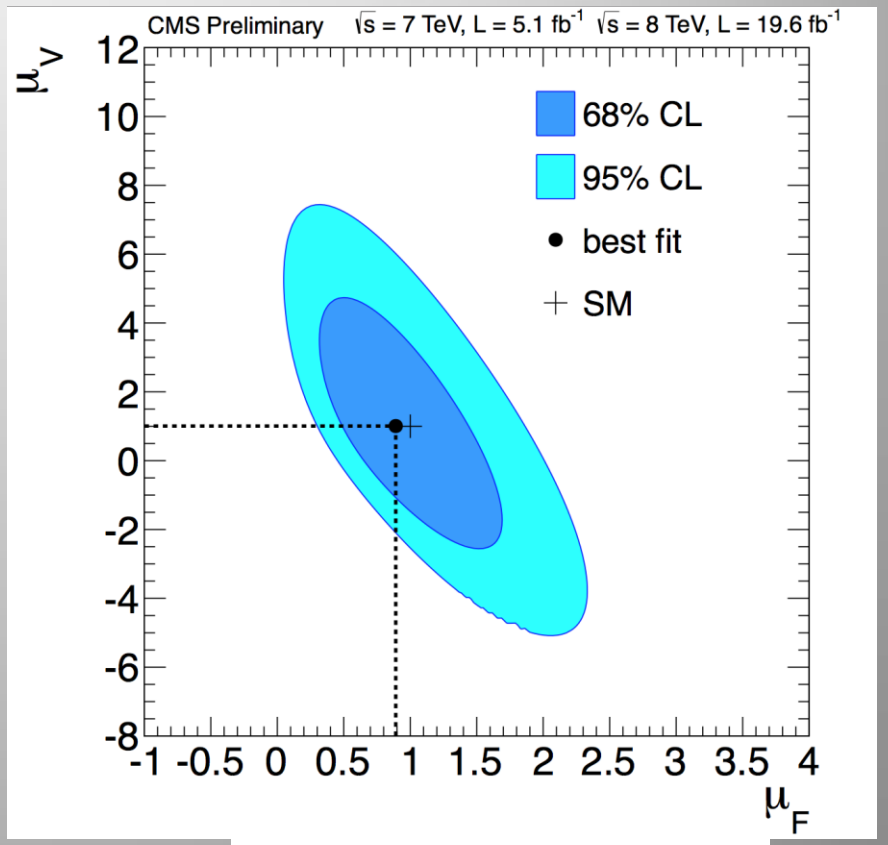
The Decay H → ZZ → 4l

Mass Measurements



M_H= 125.8 ± 0.5(stat.) ± 0.2(syst.) GeV.

Coupling scale factors to vector bosons and fermions

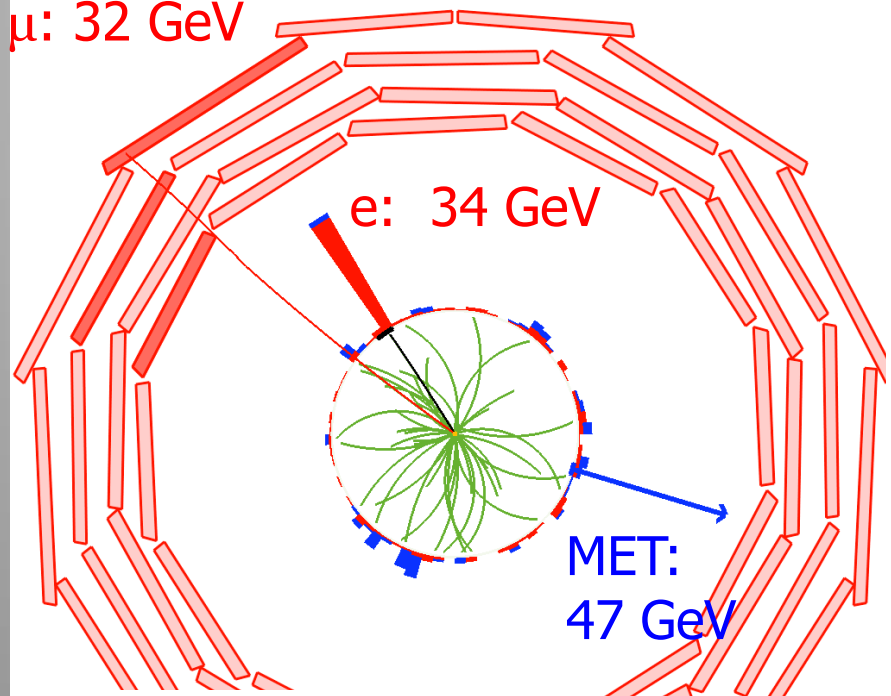


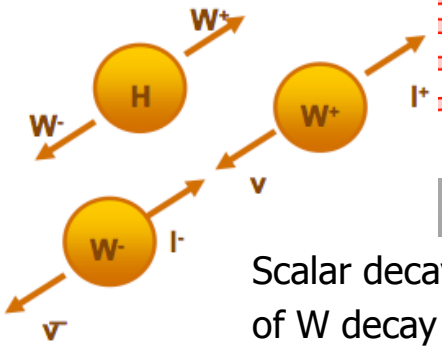
$\mu_V\ (qqH,\ ZH,\ WH) = 1.0^{+2.4}_{-2.3}$

$\mu_F\ (gg \to H,\ t\bar{t}H) = 0.9^{+0.5}_{-0.4}$

The Decay H → WW → 2l 2ν

CMS-PAS-HIG-13-004





Scalar decay and V-A structure of W decay lead to a small opening angle between leptons

Analysis

- Two opposite charged leptons (leptons only e, μ)
- Two neutrinos == missing transverse energy (MET)
- No Higgs mass peak
- Counting & 2D shape analyses
- Enhance sensitivity by subdividing into + (0,1,2) jets categories

Analysis challenges

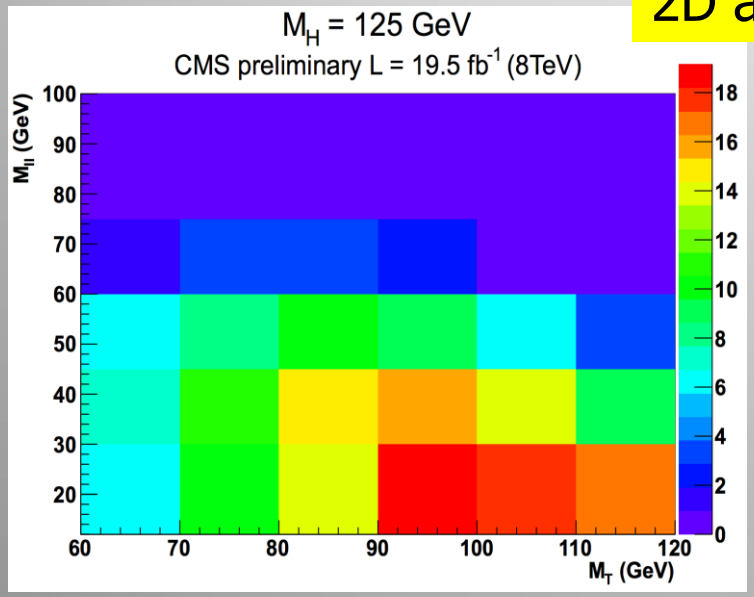
- Understand backgrounds WW, W+jets, top, Drell-Yan
- Determined from control regions

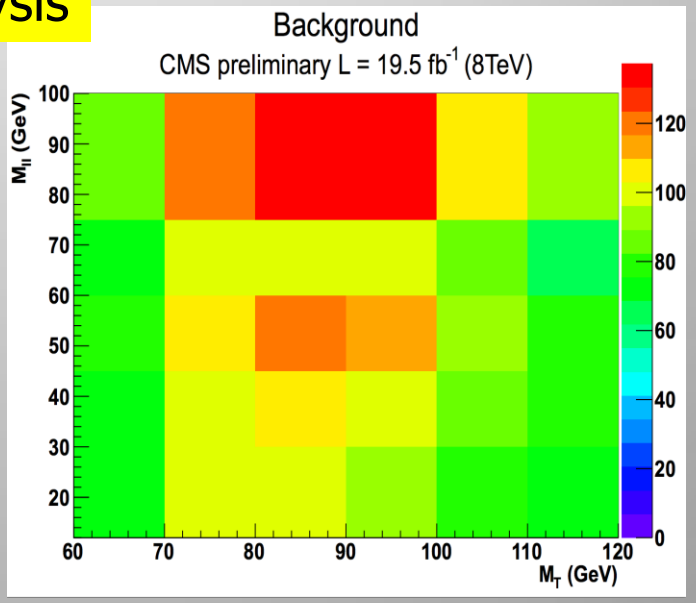
The Decay H → WW → 2l 2ν

- Analysis on the full data set for WW+0 jets and +1 jets categories
  The W+2jets (VBF) channel is in progress
- Use a cut based analysis for same flavour lepton events and 2-dimensional M_T-M_{ll} analysis for different flavour events

$$M_T = \sqrt{2 p_T^{\ell\ell} E_T^{miss} \cos(\Delta\phi_{\ell\ell} - E_T^{miss})}$$

2D analysis

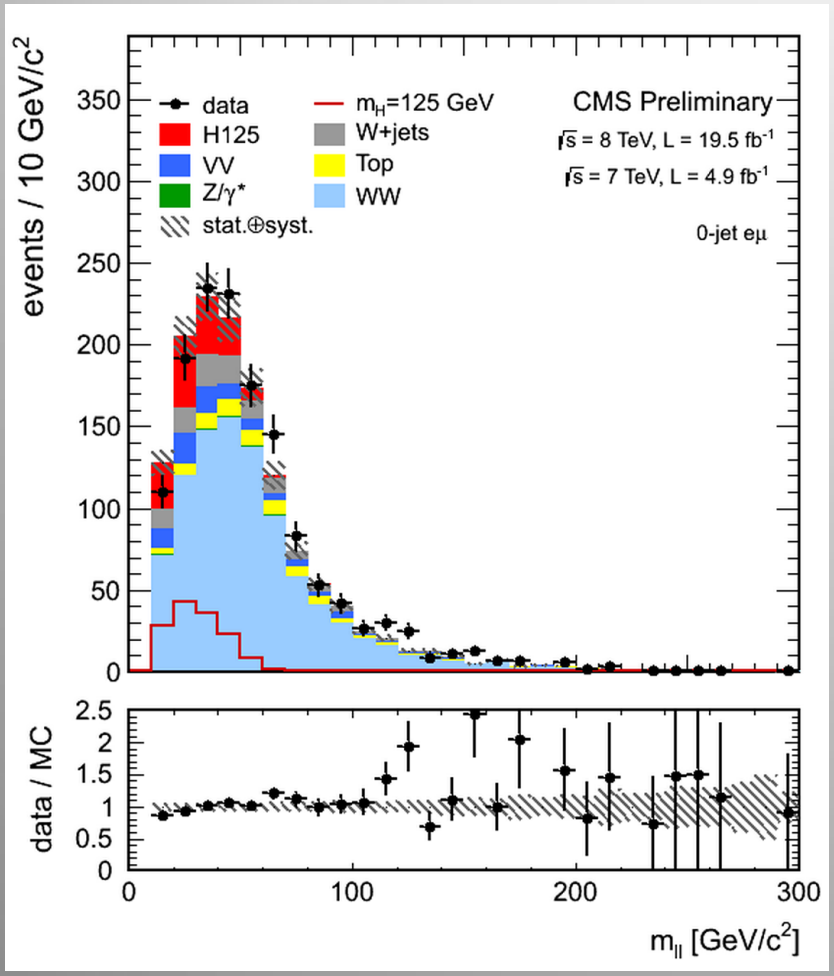


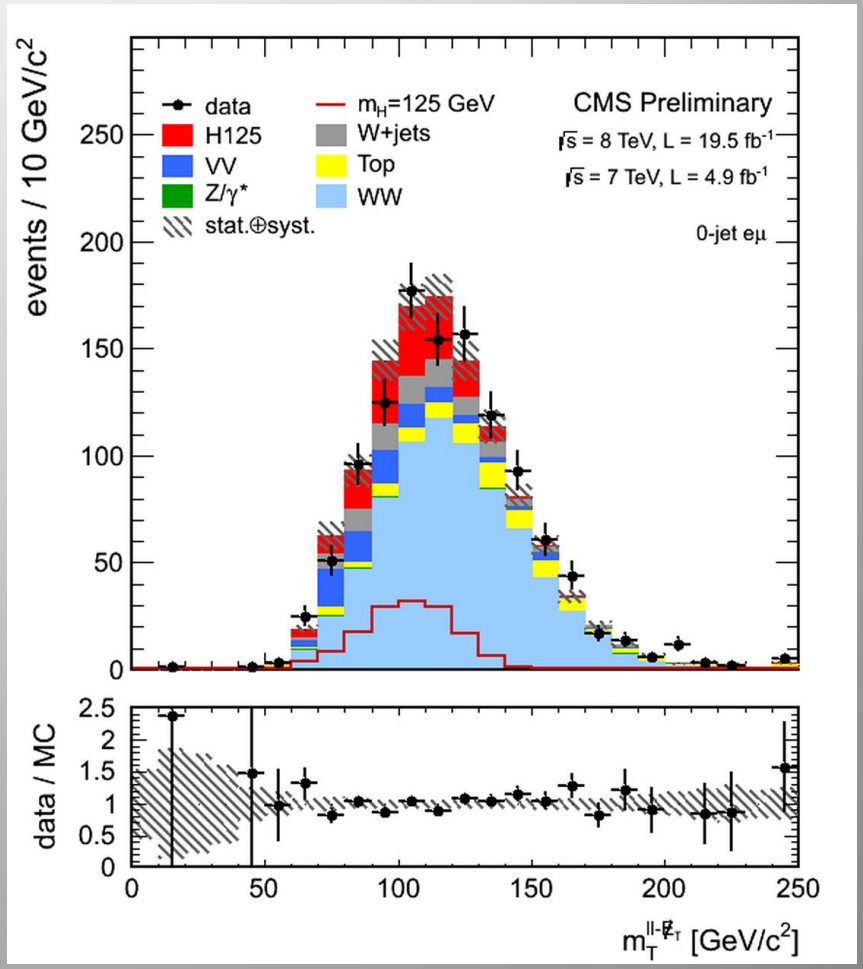


final state	cut-based approach	shape-based approach
DF 0-jet	counting	2D $m_{\ell\ell}$-m_T
SF 0-jet	counting	counting
DF 1-jet	counting	2D $m_{\ell\ell}$-m_T
SF 1-jet	counting	counting

The Decay H → WW → 2l 2ν

Events with 0 jets and different flavour leptons (7+8 TeV Data)

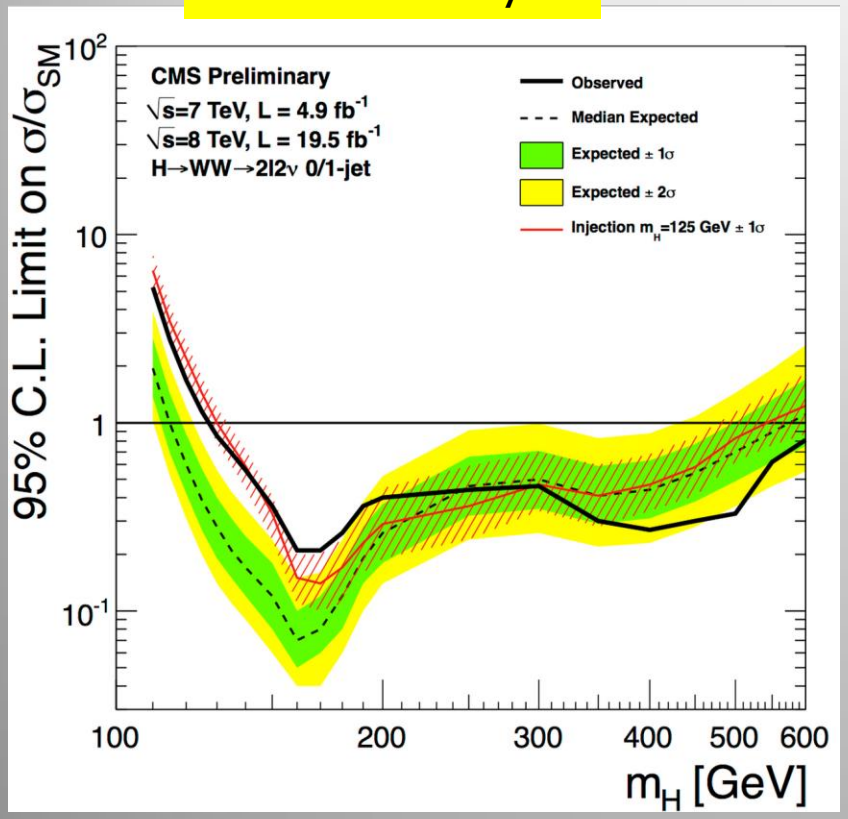




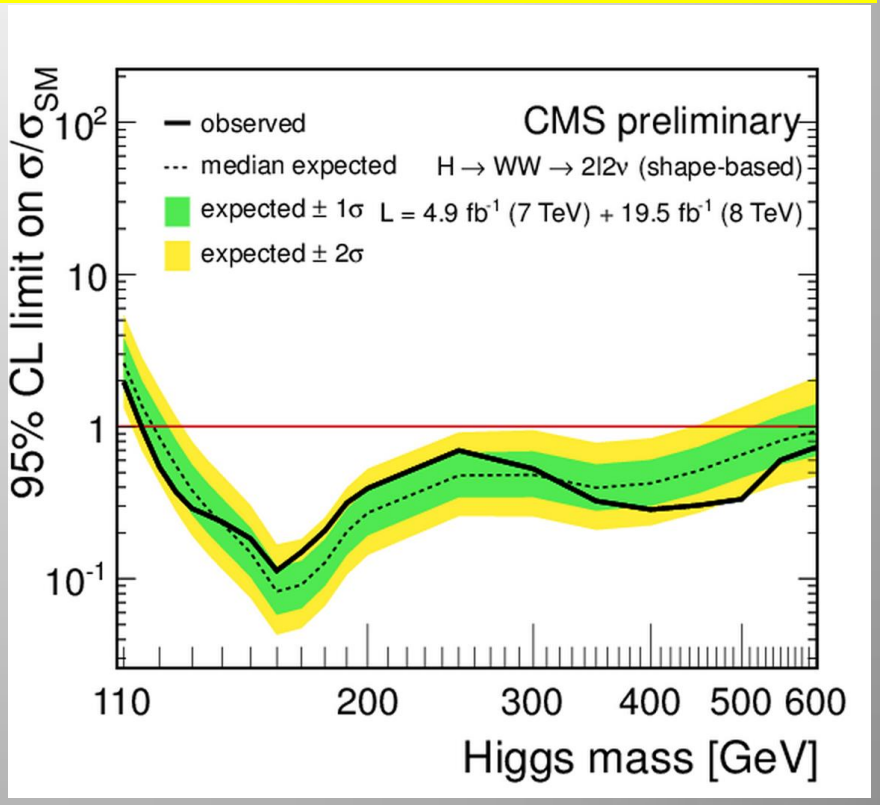
A significant excess is observed…

The Decay H → WW → 2l 2ν

Standard Analysis

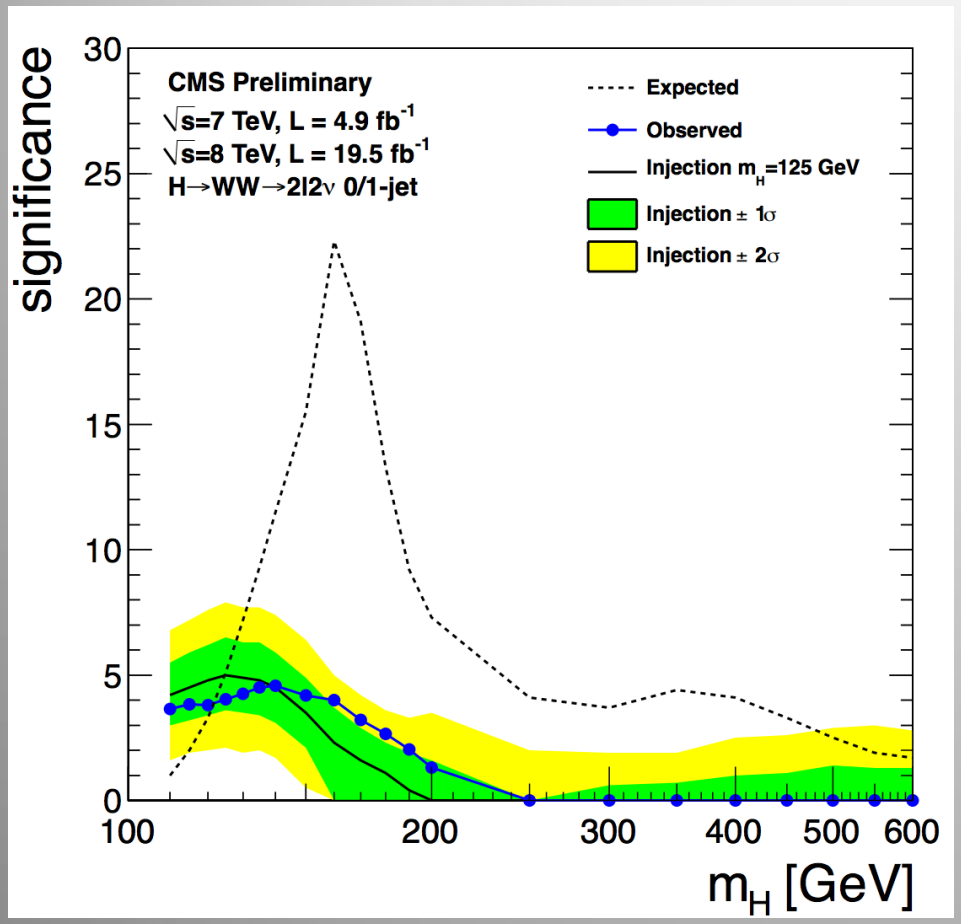


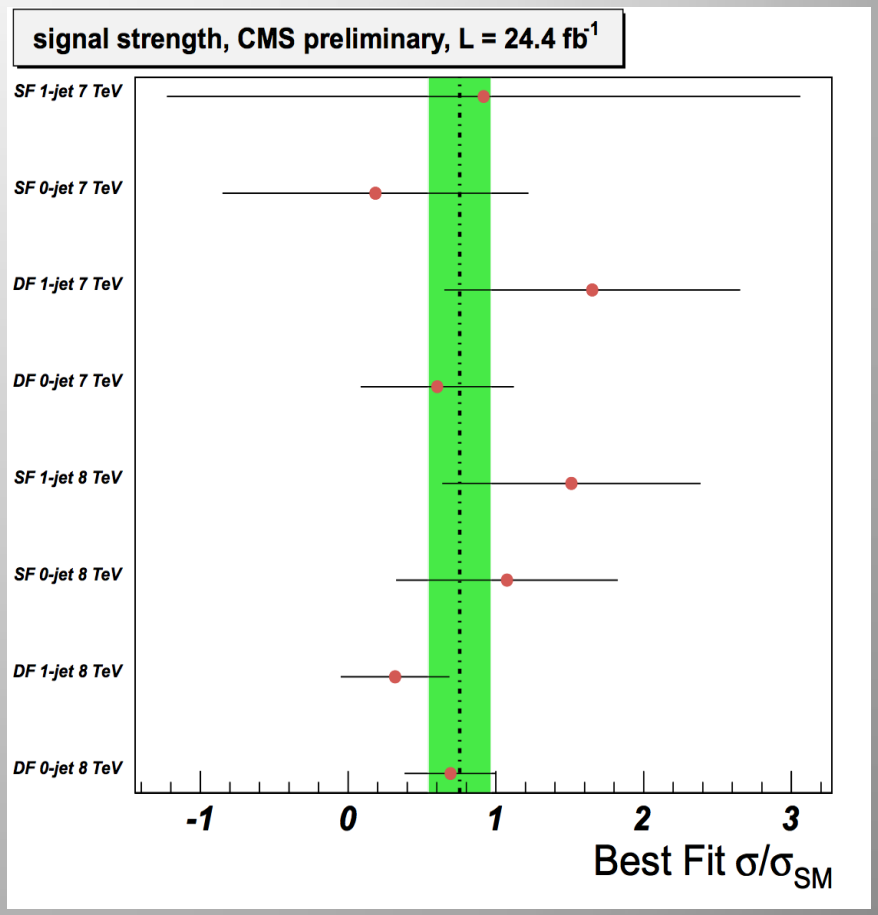
Using m_H = 125 GeV as a "background"



- Exclusion at 95% in the mass range 128-600 GeV
- Large excess in the low mass region
- When including M_H=125 GeV as part of the background, no significant excess is seen over the entire mass range

The Decay H → WW → 2l 2ν





A 4.0σ (5.1σ) observed (expected) significance at $m_H \sim 125$ GeV

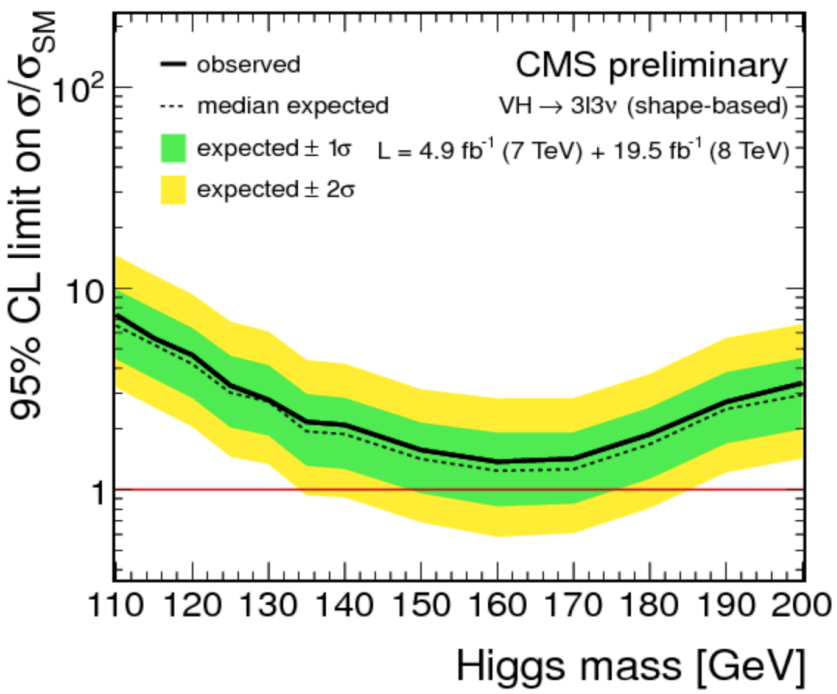
σ/σ_{SM} signal strength: 0.76 ± 0.21

Associated Production VH H →WW

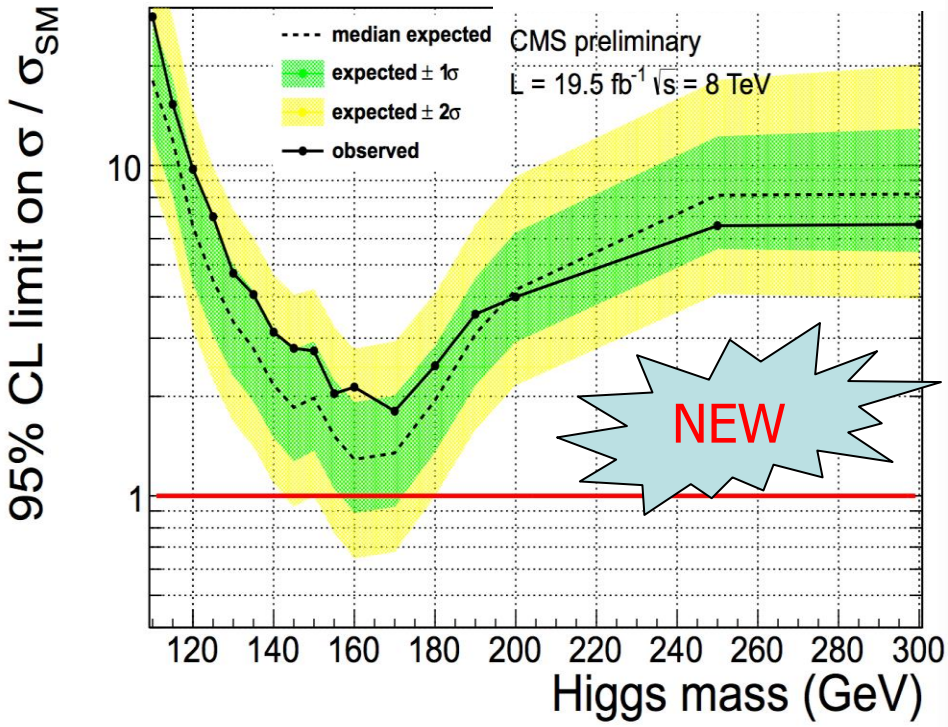
WH → WWW → 3l 3ν

VH → VWW→2l 2ν + V→jj

CMS-PAS-HIG-13-009



CMS-PAS-HIG-12-017



- Three high p_T leptons with moderate missing transverse momentum
- WW analysis cuts plus two central jets

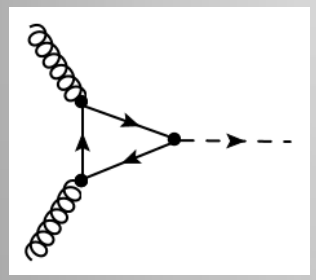
Limited Standard Model Higgs sensitivity (~ 3.5-4•SM at 125 GeV)

Higgs Decay into Fermions

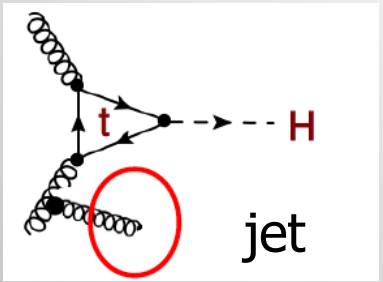
The Decay H →ττ

Topologies studied

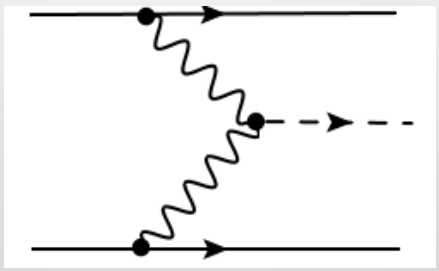
CMS-PAS-HIG-13-004



Inclusive 0-jets



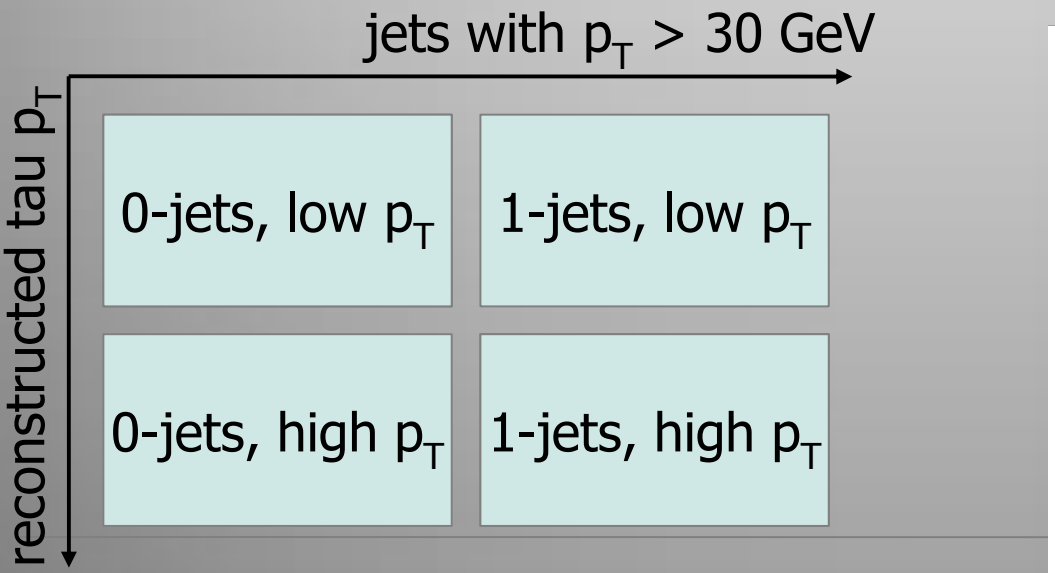
Boosted 1-jet

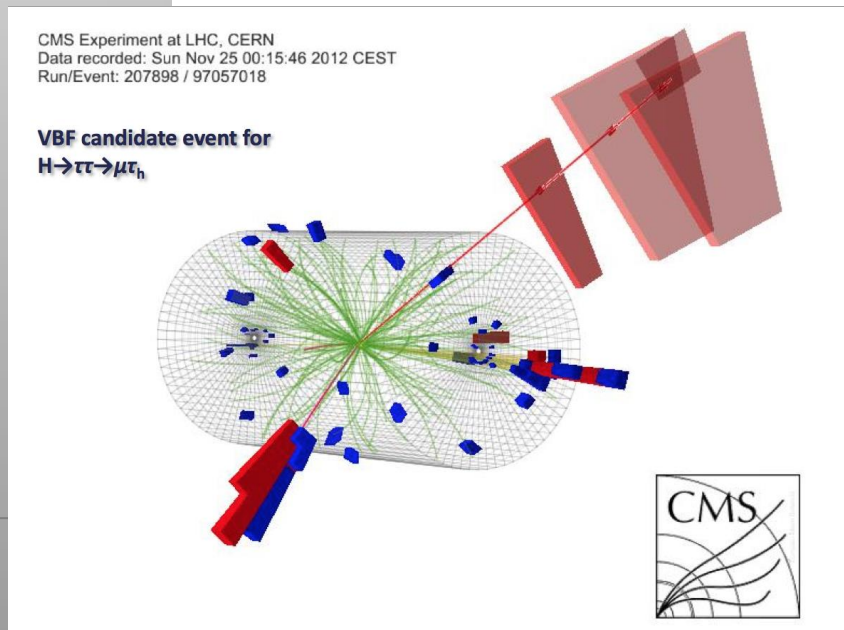


VBF 2-jets

Analysis

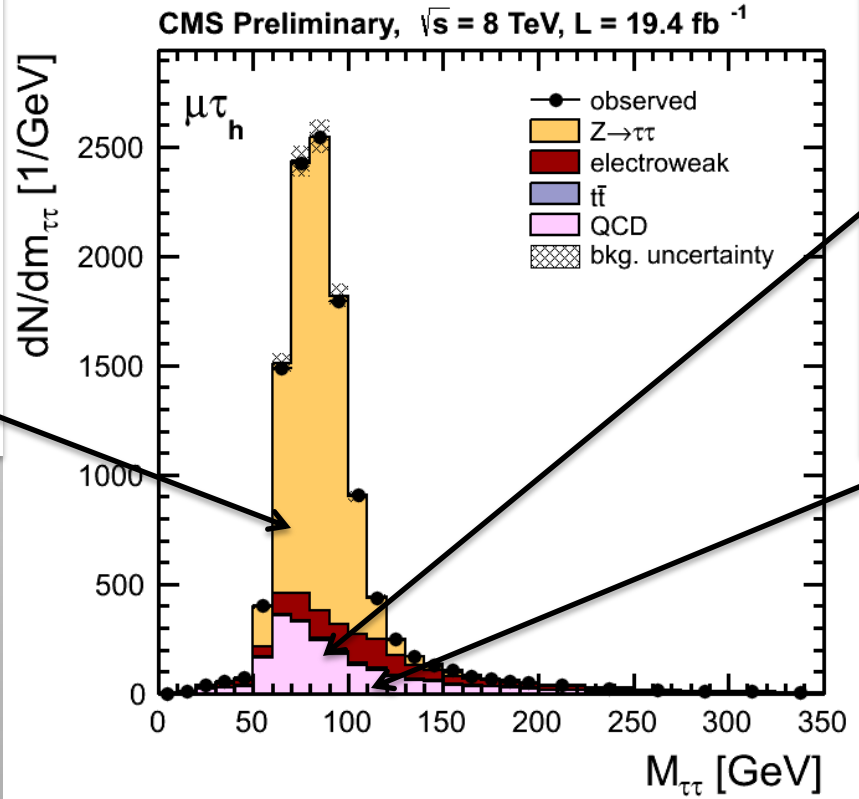
- Tau decays to e, μ, τ_{had} used to reconstruct a tau
- Reconstruct corrected ττ invariant mass
- Use many categories to increase the sensitivity





The Decay H →ττ

Z→ττ Embedding:
Z→μμ data,
replace μ with
simulated τ decay
Normalization
from Z→μμ data
Syst: 5%

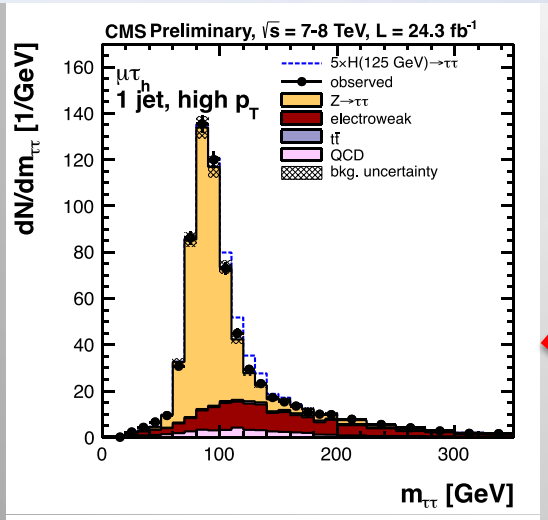


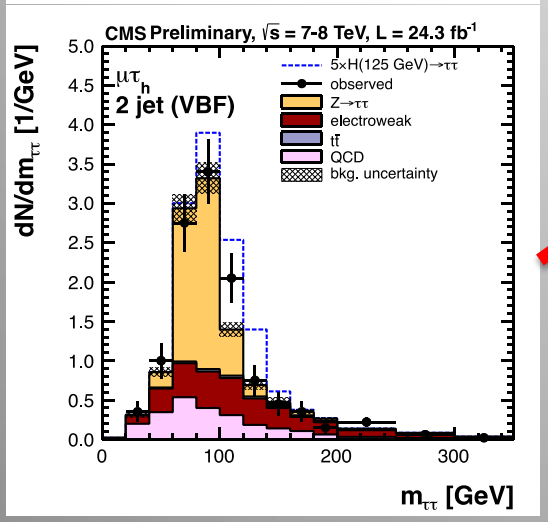
W+jets
Shape from
simulation
Normalization
from control
region
Syst: 10-20%

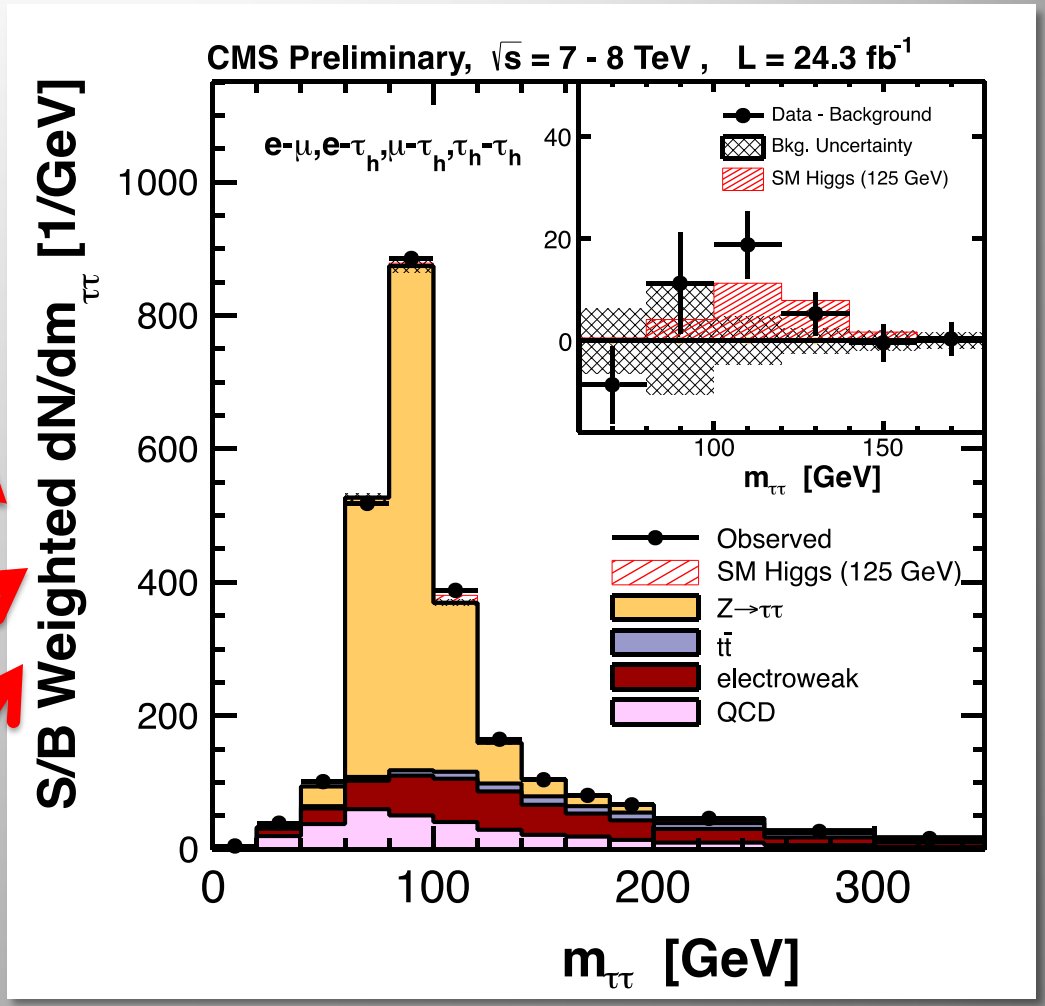
QCD
SS lepton data,
corrected for
SS/OS lepton ratio
Syst: 10%

- Select isolated, well-identified leptons, τ_h
- Topological cuts (e.g. m_T in $l\tau_h$) to suppress backgrounds
- Categorize events based on number of jets, τ-p_T
- Template fit to $m_{\tau\tau}$ shape

The Decay H →ττ





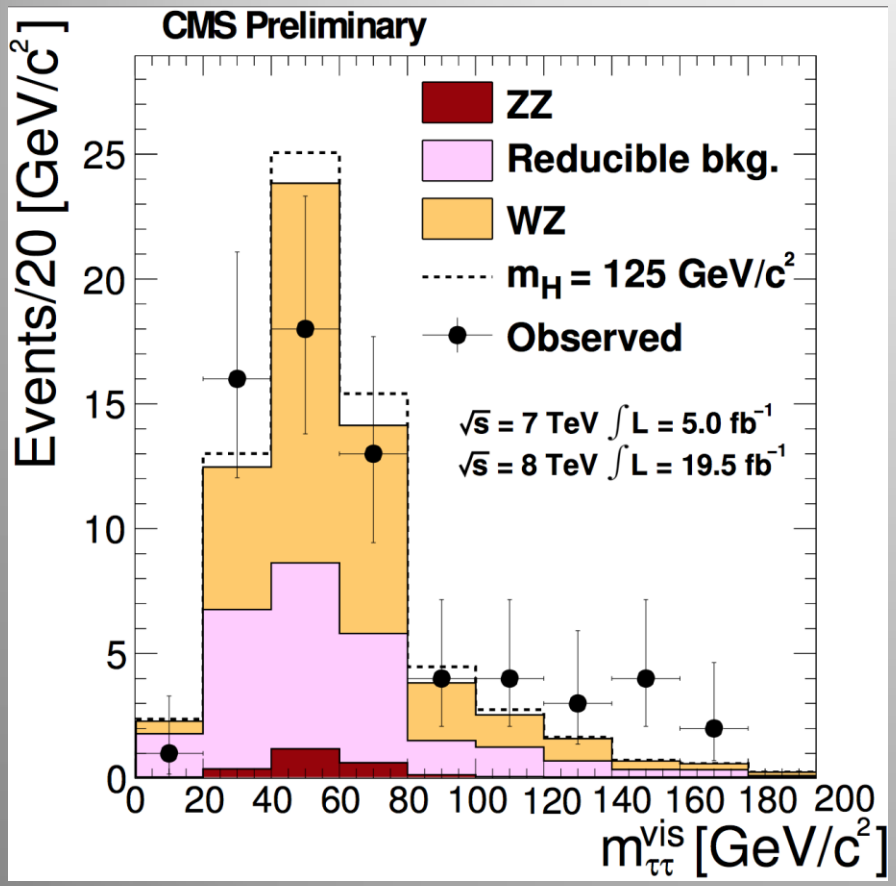


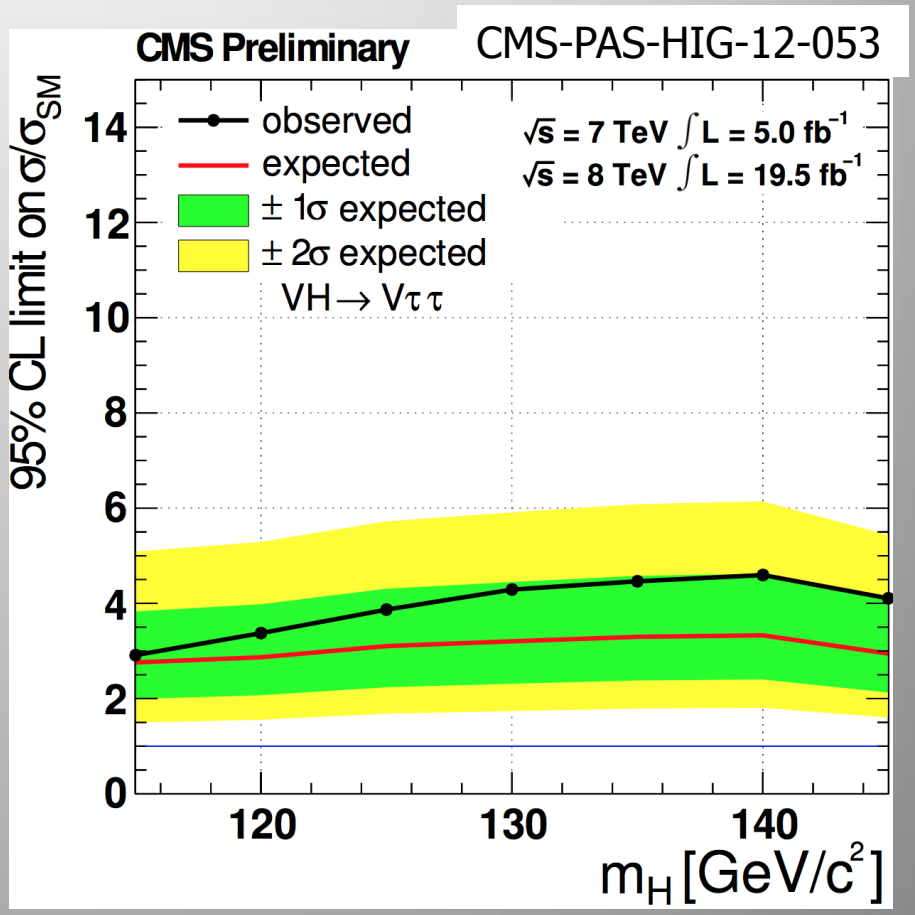
…plus all other tau decay modes: $e\tau_h$, $e\mu$, $\mu\mu$, $\tau_h\tau_h$

Combine the sensitive categories of all channels with a S/B weight

Associated Production VH → Vττ

- Study topologies of 3 and 4 lepton final states
- Use tau decay channels into electrons muons and hadronic final states

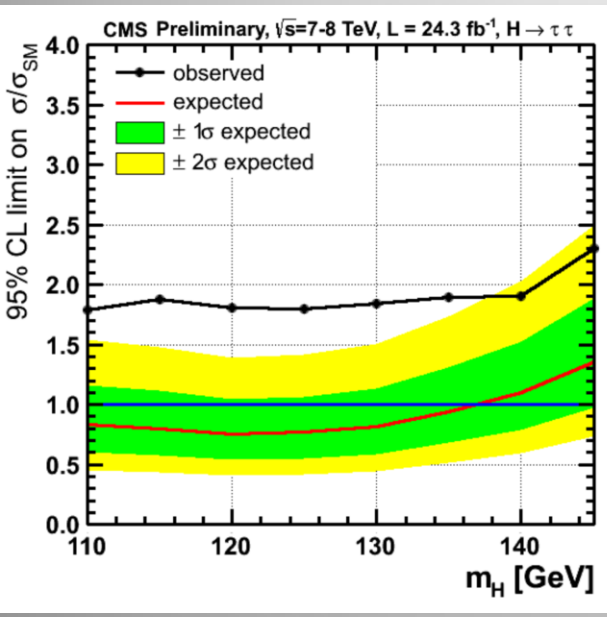


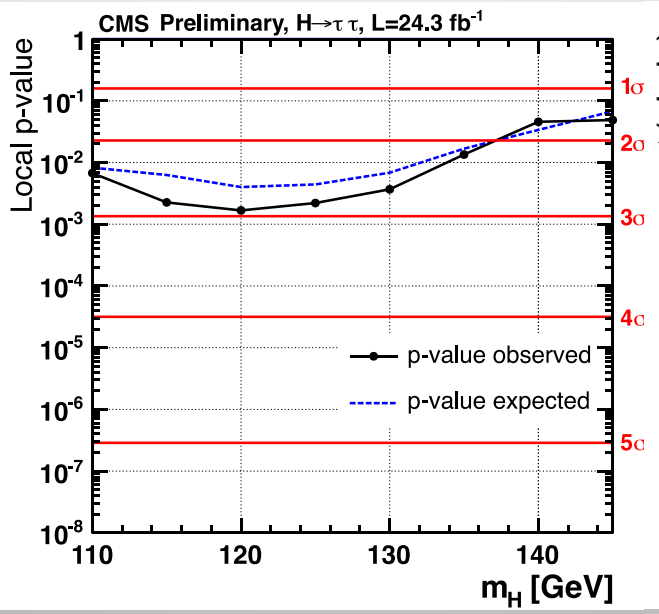


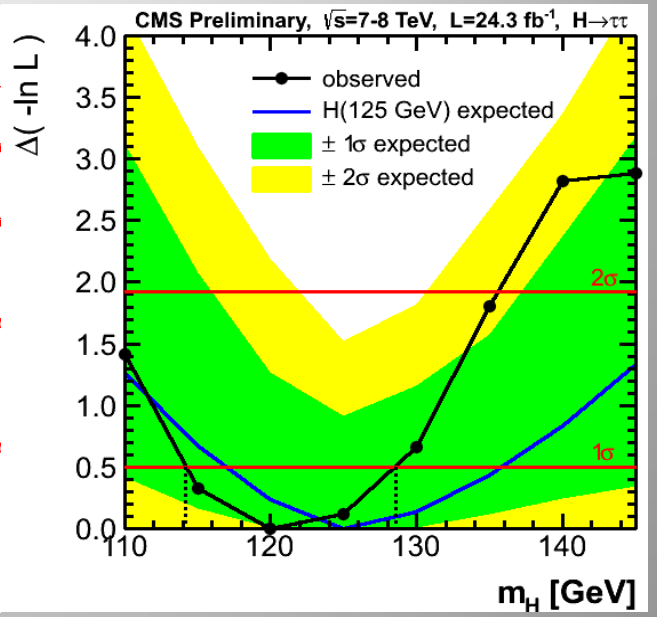
Upper limits of 2.9 to 4.6 times the predicted Standard Model value for σ•BR at 95% CL.

The Decay H →ττ

Results include also the VH channels







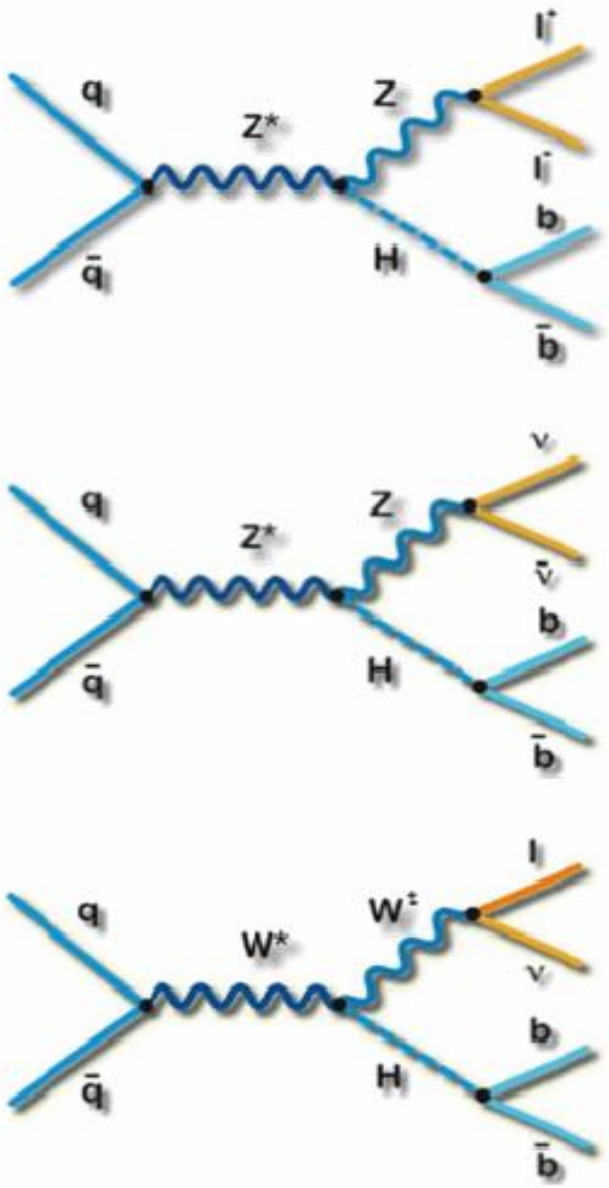
Significance:
2.93σ for m_H = 120 GeV
2.85σ for m_H = 125 GeV

Signal strength
$\mu = 1.1 \pm 0.4$

Mass: all ττ channels combined
$m_H = 120^{+9}_{-7}$ (stat+syst) GeV

Excess building up in the region 120-130 GeV

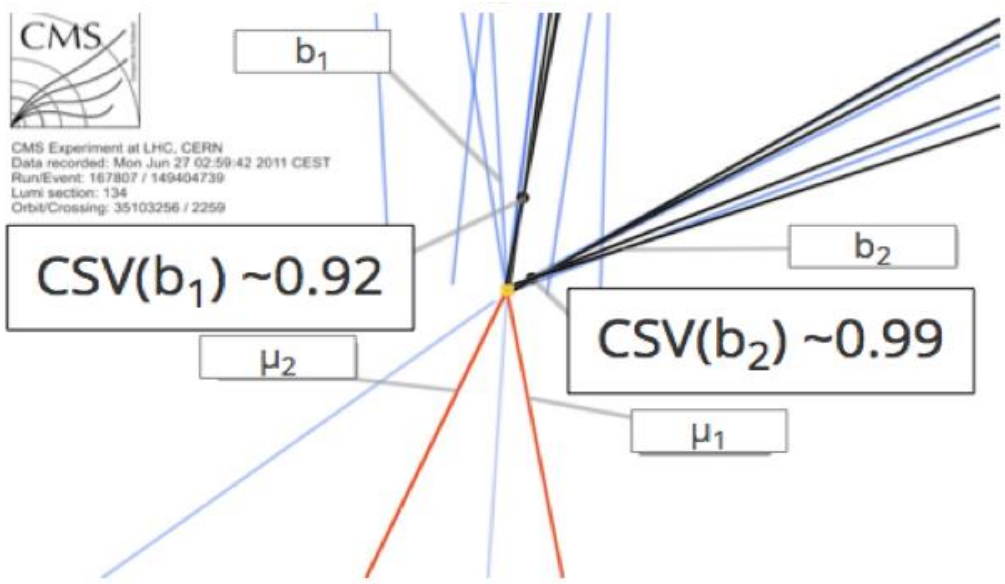
The Decay H→bb



Analysis

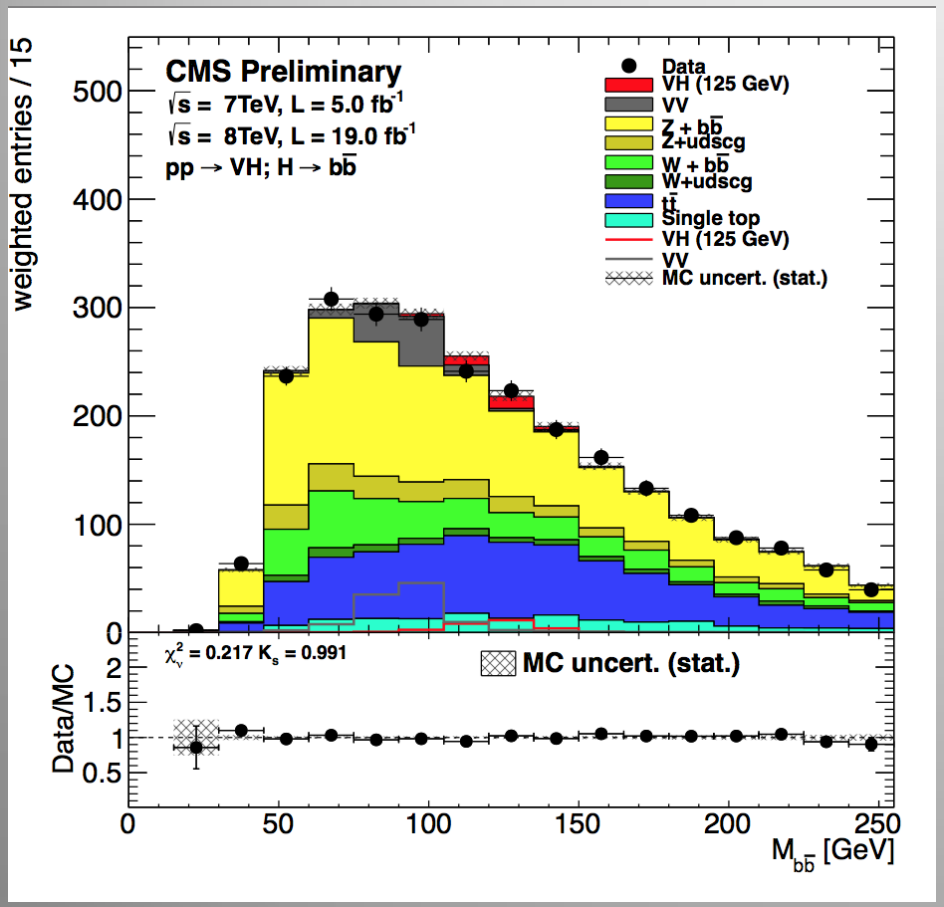
CMS-PAS-HIG-13-012

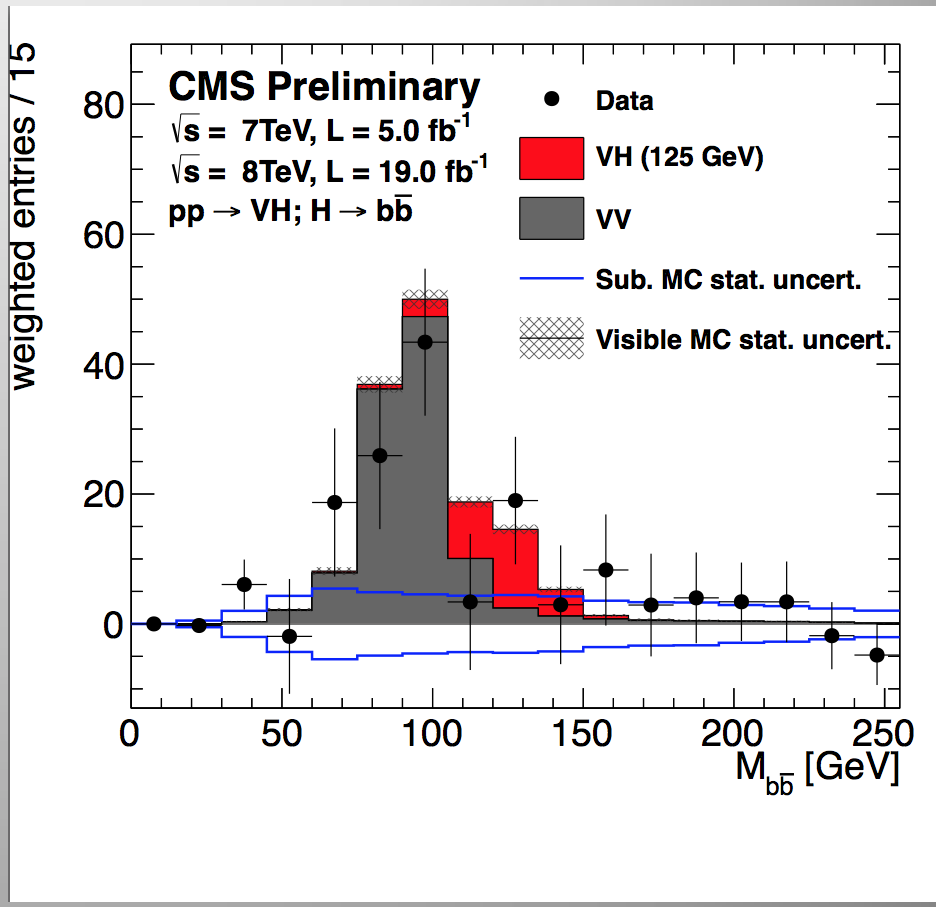
- By far largest number of Higgs decays
- But lots of QCD background (jets)
- Trigger based on leptons and missing E_T
- b-jets identified through displaced tracks
- Go to high p_T where Higgs is enhanced
- Main background W/Z+jets and top



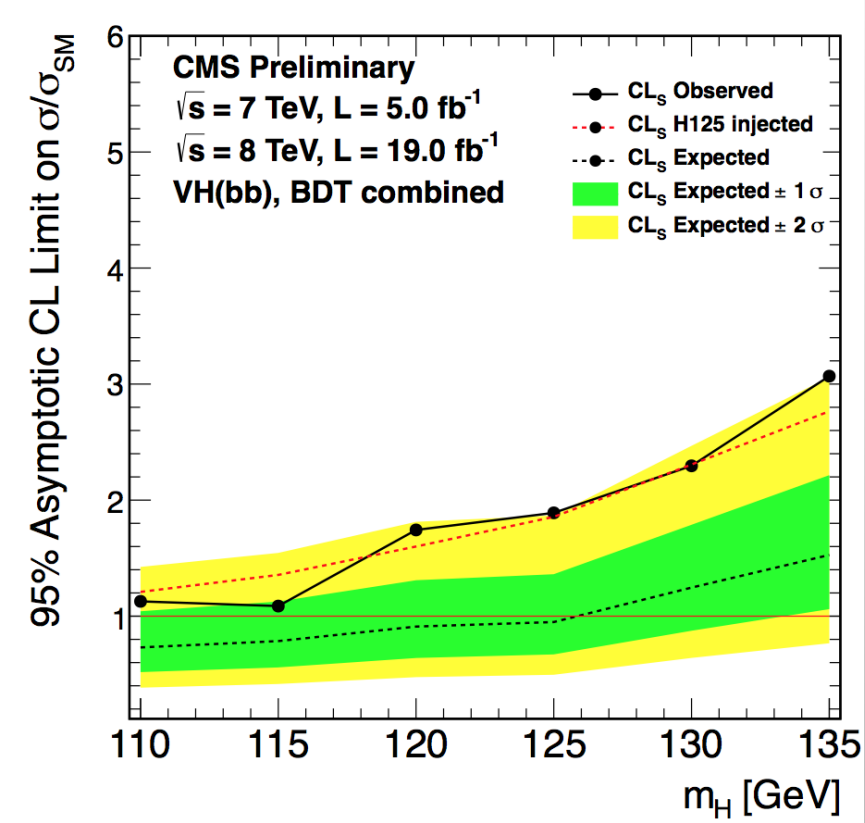
The Decay H→bb

$M_{b\bar{b}}$ for all categories and 7+8 TeV

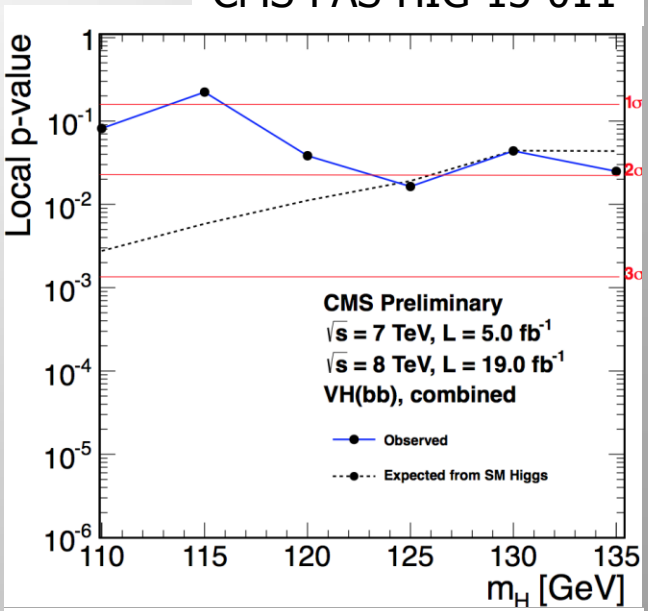


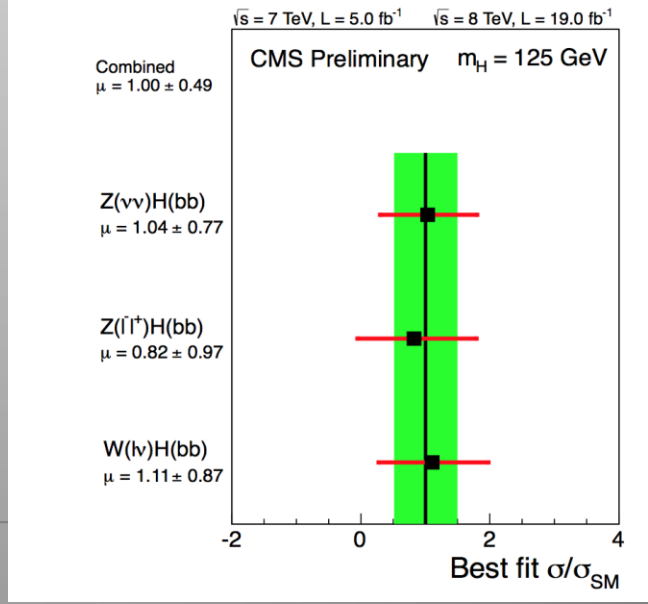


The Decay H→bb



CMS-PAS-HIG-13-011



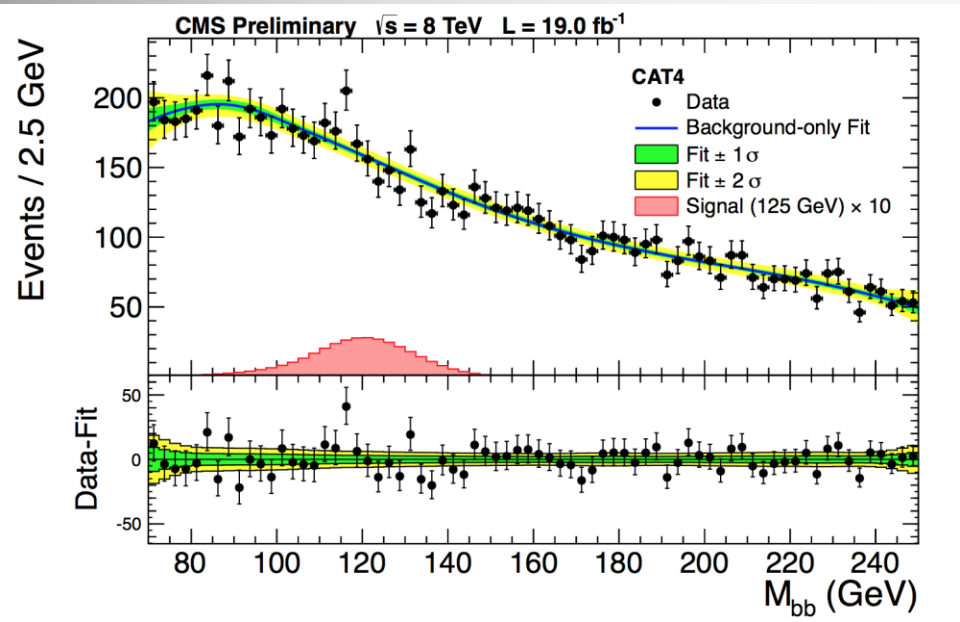


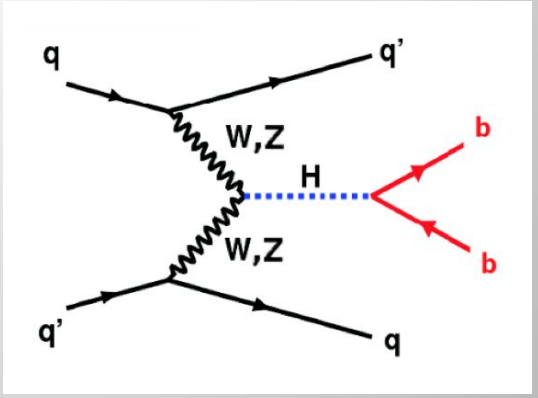
For 125 GeV:

- Significance = 2.1σ (2.1σ expected)
- Signal strength μ = 1.0± 0.5

Mild excess observed in data.

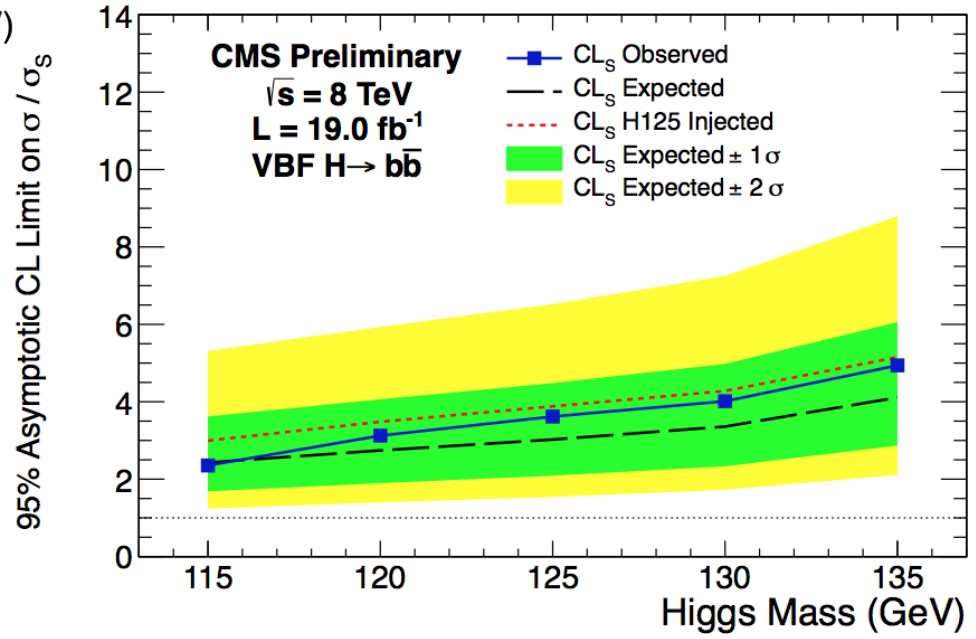
VBF Process with H→bb





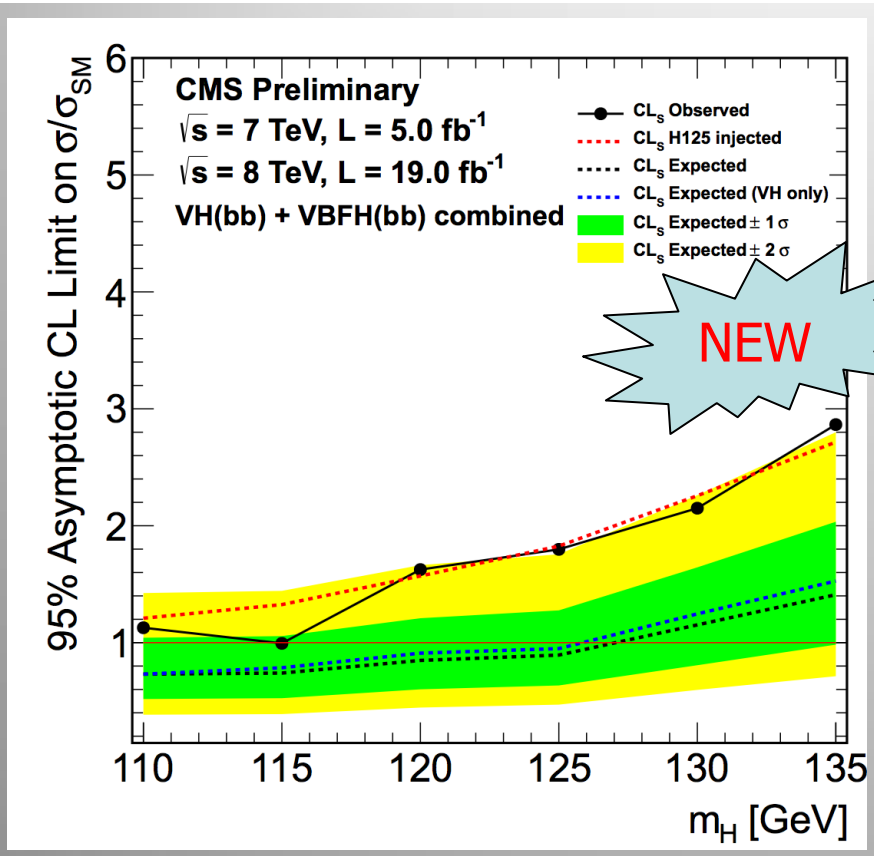
bb event + ≥ 2 non-b jets at large Δη

At 125 GeV the upper limit on σ•BR = 3.6•SM (3.0 exp.)

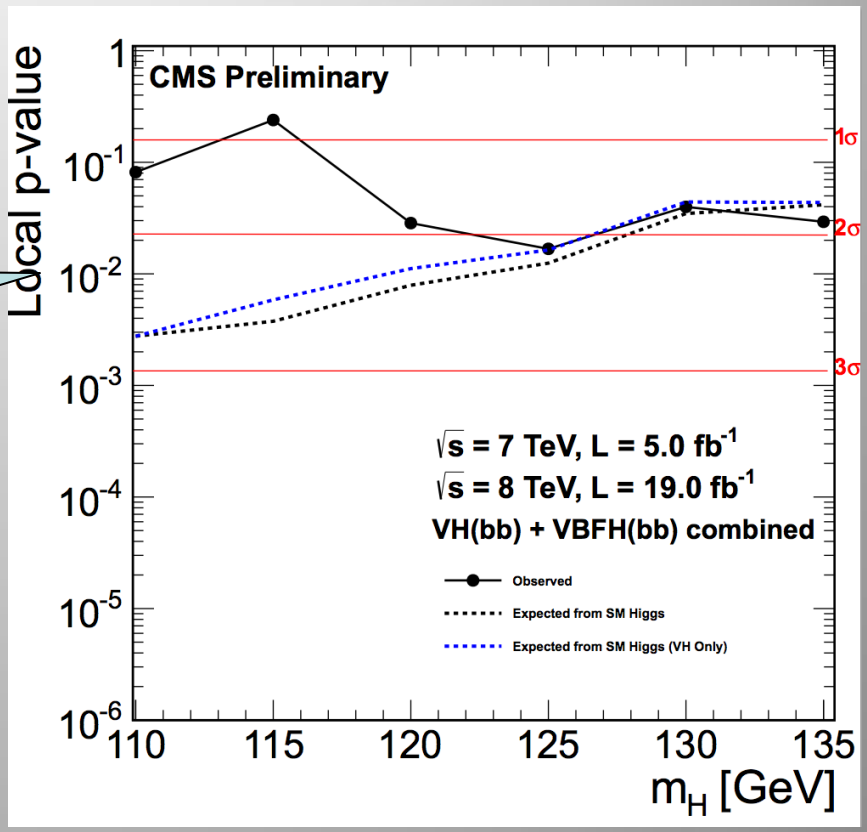


H→bb Channel Combination

Combine the results of the VBF and VH processes for H→bb



NEW



- 95% CL limit observed (expected) at 125 GeV: 1.79 (0.89)
- Significance observed (expected) at 125 GeV : 2.1σ (2.2σ)
- Signal strength at 125 GeV: μ= 0.97± 0.48

Higgs Associated with Top Production

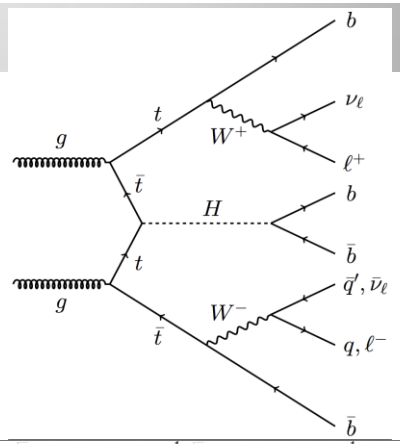
5/fb at 7 TeV +
5/fb at 8 TeV

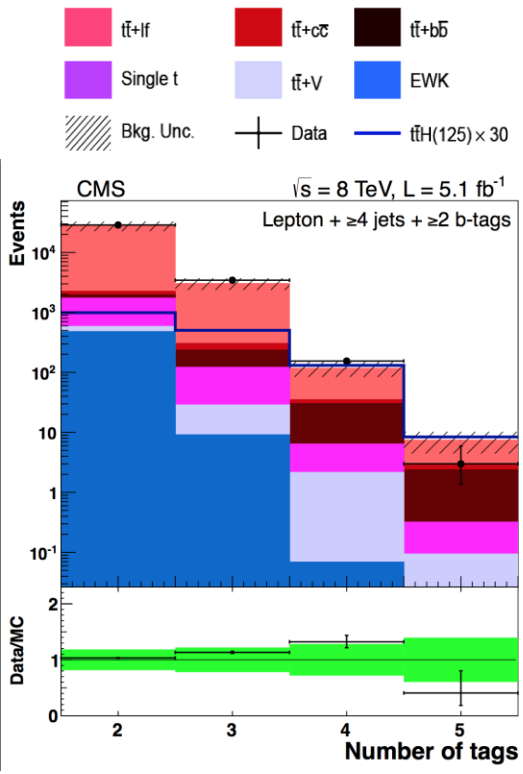
Study of the channel

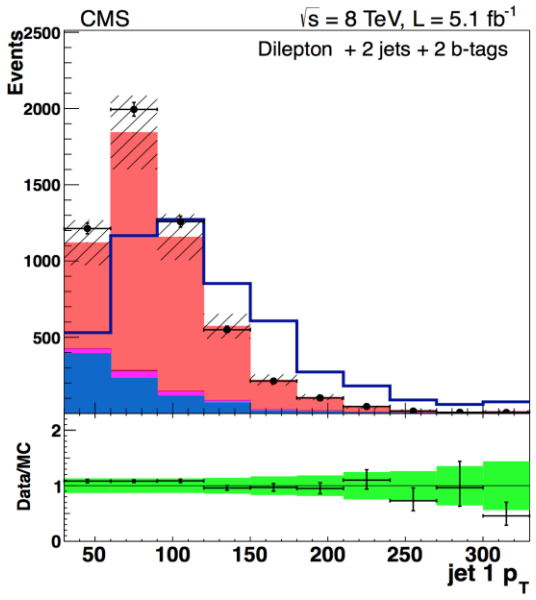
$H \rightarrow bb$

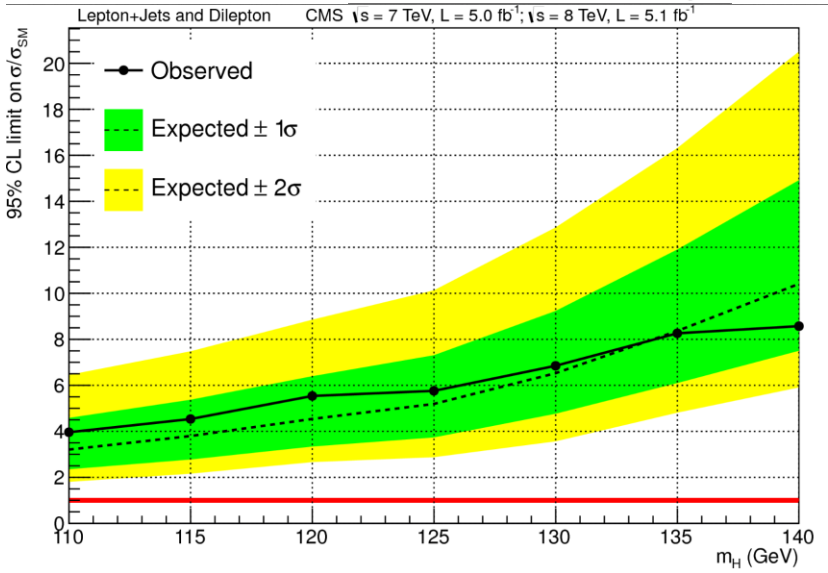
- Analyses for di-lepton and lepton+jets ttbar decays
- Neural net technique
- Analysis optimized for H→bb

CMS-PAS-HIG-12-035
Publ. JHEP05 145 (2013)





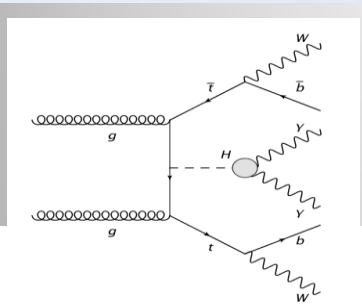




Data compatible with background expectations

Limit on σ•BR: Exp:5.2 Obs:5.8 for m_H=125 GeV

Higgs Associated with Top Production

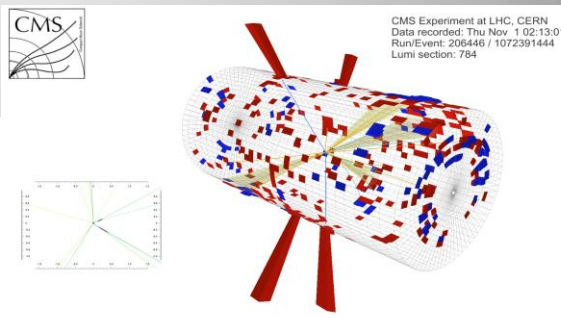


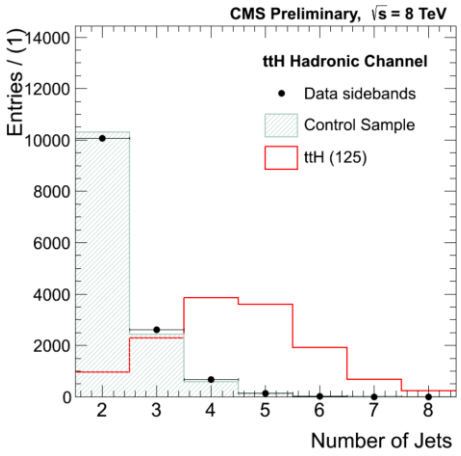
- Study of the channel

$$H \rightarrow \gamma\gamma$$

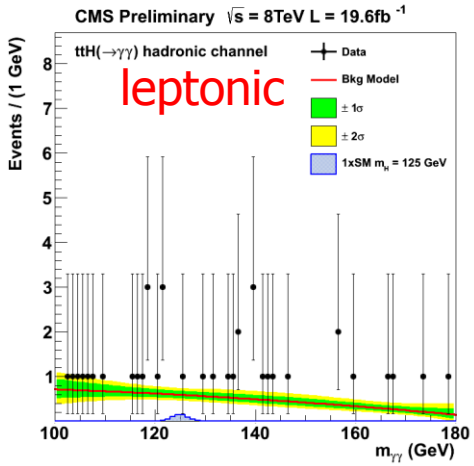
- Perform analyses for leptonic and hadronic ttbar decays
- Sensitivity σ.BR ~ 5.3.SM for 125 GeV

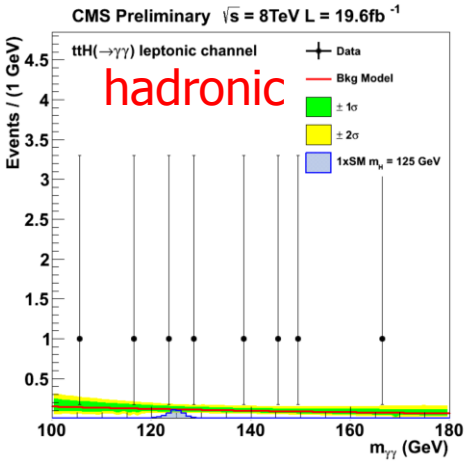
CMS-HIG-13-015

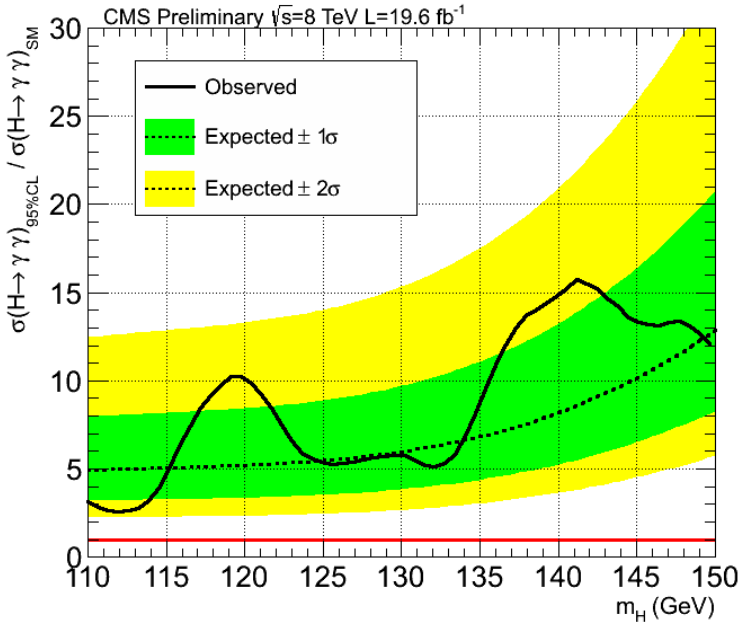




limits	Observed	Expected	Expected (No Syst.)
Hadronic Channel	6.8	9.2	8.8
Leptonic Channel	10.7	8.0	7.7
Combined	5.4	5.3	5.1

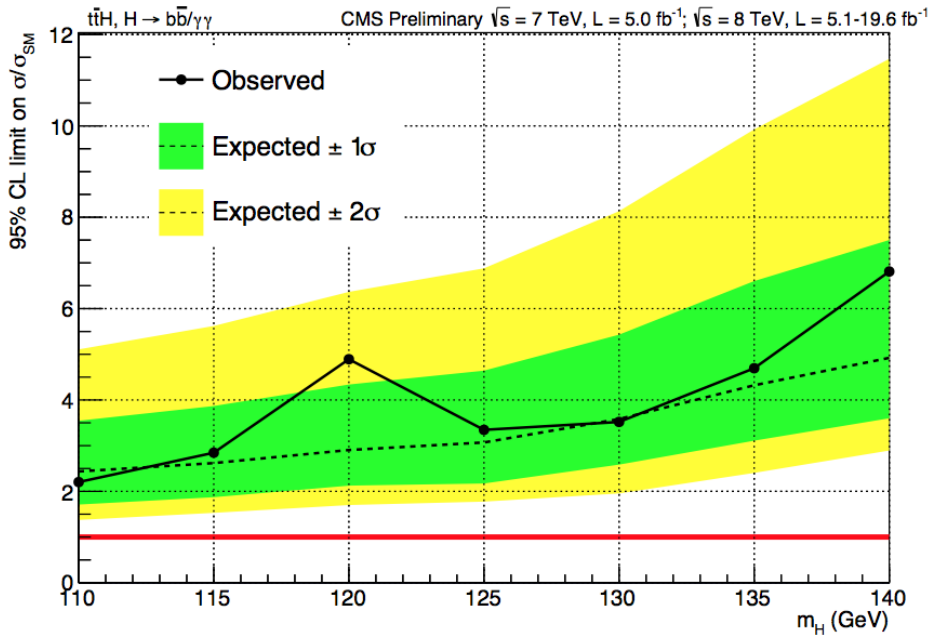






ttH Combination

Combination of the ttH->2 photons with ttH->bb result



NEW

The expected 95% CL upper limits on the signal strength parameter $\mu = \sigma / \sigma_{SM}$ as a function of Higgs mass for the combination of channels

Higgs Mass	Observed	Expected Median	Expected 68% C.L. Range	Expected 95% C.L. Range
110 GeV^2	2.2	2.4	[1.7,3.5]	[1.4,5.1]
115 GeV^2	2.8	2.6	[1.9,3.9]	[1.5,5.6]
120 GeV^2	4.9	2.9	[2.1,4.3]	[1.7,6.4]
125 GeV^2	3.3	3.1	[2.2,4.6]	[1.8,6.9]
130 GeV^2	3.5	3.6	[2.6,5.4]	[2.0,8.1]
135 GeV^2	4.7	4.3	[3.1,6.6]	[2.4,9.9]
140 GeV^2	6.8	4.9	[3.6,7.5]	[2.9,11.5]

Observed limit at 125 GeV: 3.3
Expected limit at 125 GeV: 3.1
(95% CL)

Sensitivity to 1-2•SM within reach with full data set/all channels!

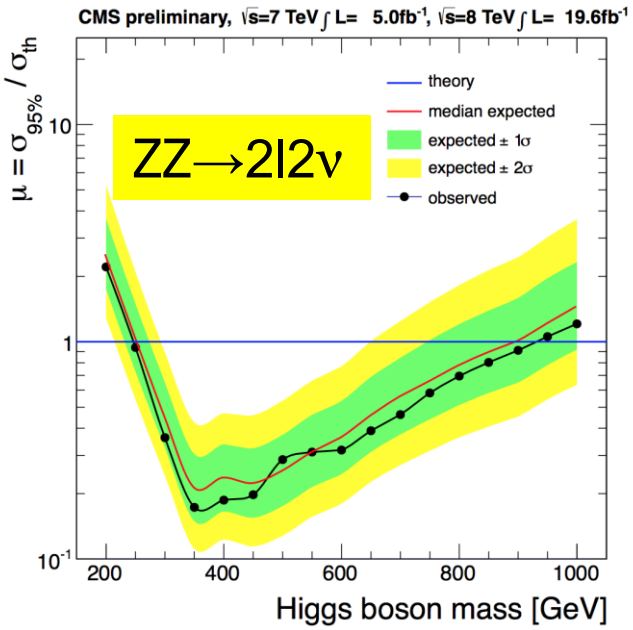
High Mass Higgs Searches

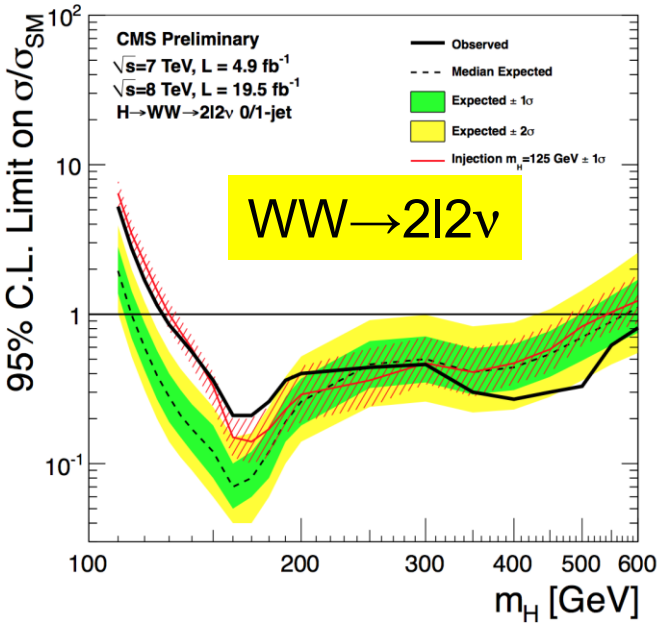
High mass Higgs searches with SM channels WW, ZZ updated with 2012 Statistics

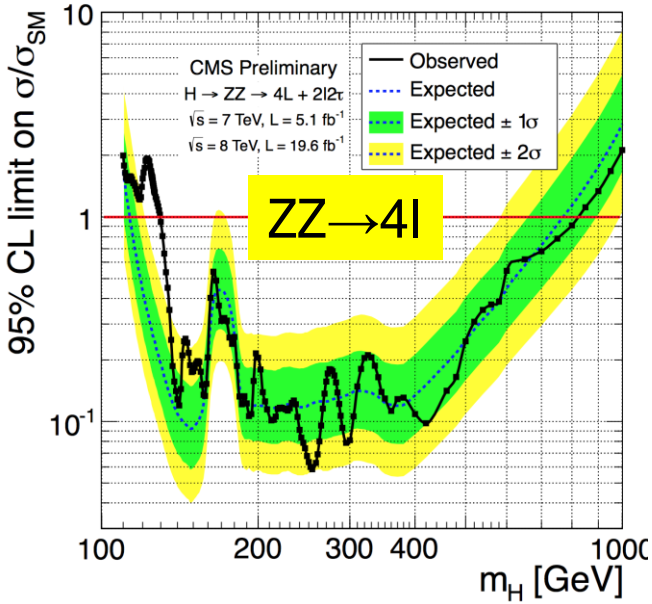
Sensitivity reaches now up to ~ 1 TeV

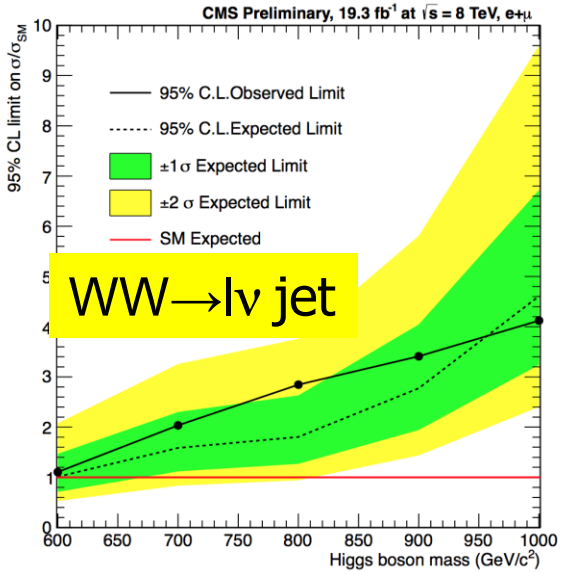
Interpretation of the data in eg EW-singlet models; Benchmark models proposed by the LHC XS WG:

See CMS-PAS-13-008
CMS-PAS-13-014

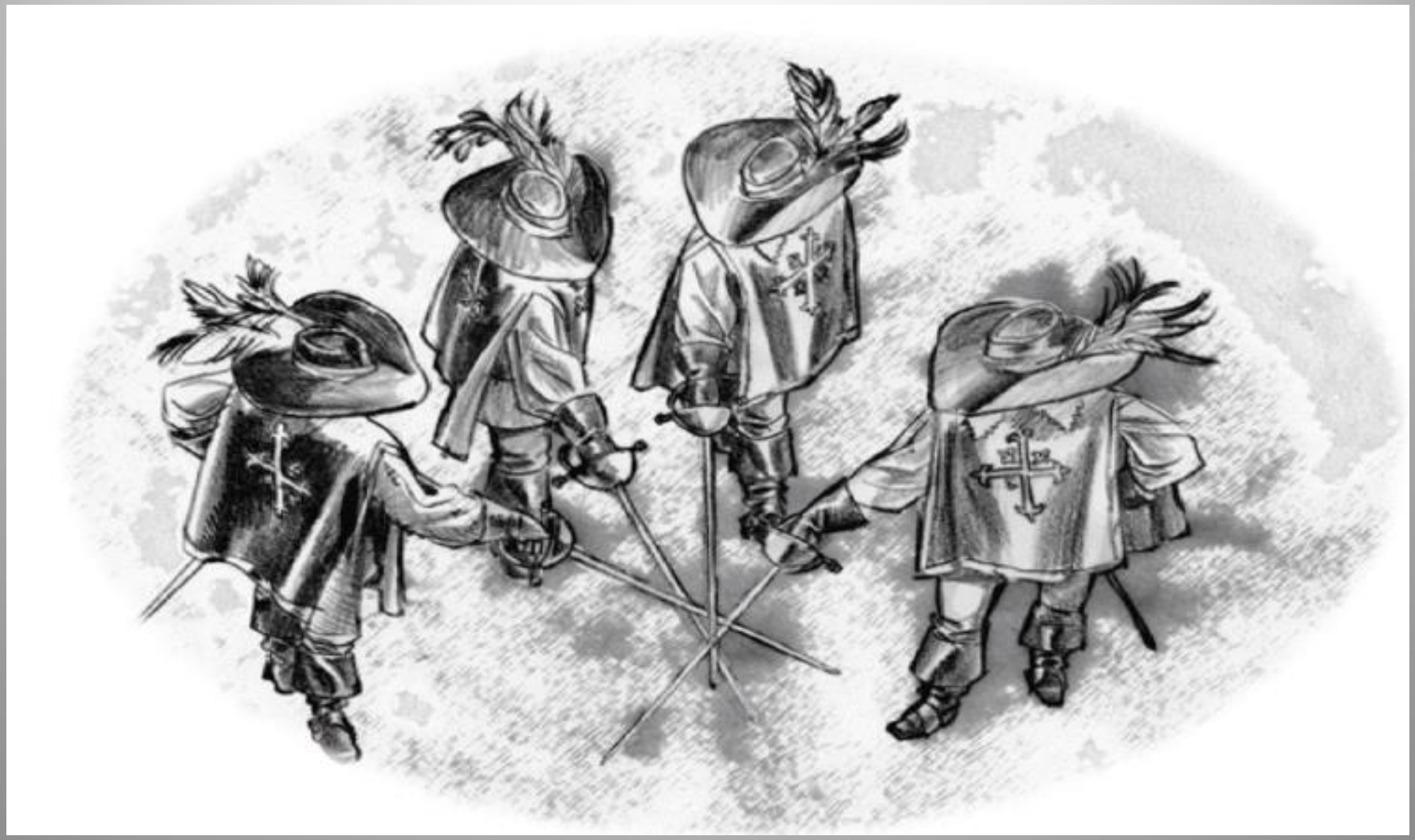








Channel Combination & Higgs Properties



Since fall 2012 we have been especially concentrating on measurements of properties of the new particle

Summary of the Five Main Channels

For a mass of m_H = 125.7 GeV

CMS-PAS-HIG-13-005

Decay	Expected	Observed
ZZ	7.1 σ	6.7 σ
γγ	3.9 σ	3.2 σ
WW	5.3 σ	3.9 σ
bb	2.2 σ	2.1 σ
ττ	2.6 σ	2.8 σ

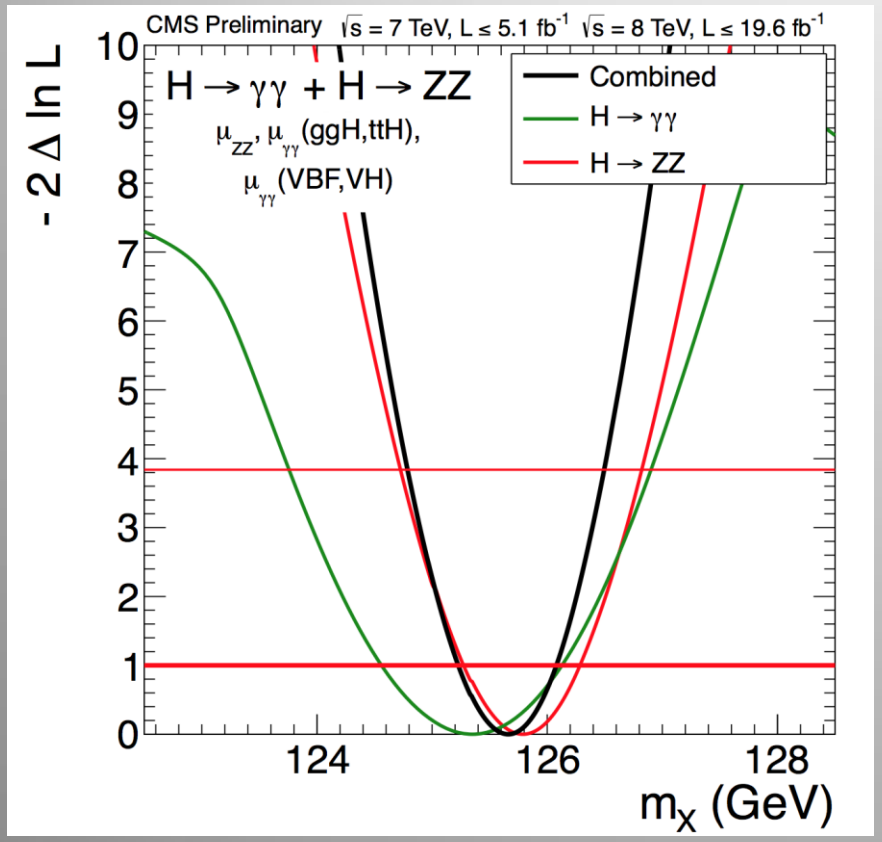
} 3.4 σ combined!

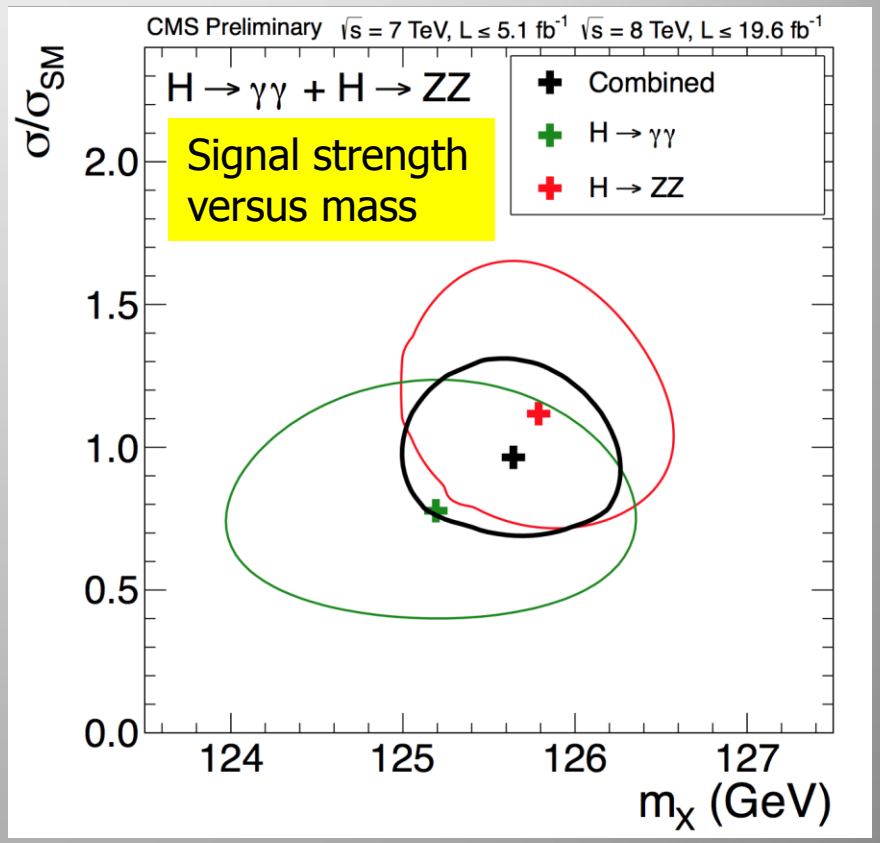
bb: includes VH and VBF
WW: includes ggF, VH, VBF

Mass of the New Particle

$H \rightarrow ZZ \rightarrow 4l$: $m_H = 125.8 \pm 0.5$ (stat.) ± 0.2 (syst.) GeV

$H \rightarrow \gamma\gamma$: $m_H = 125.4 \pm 0.5$ (stat.) ± 0.6 (syst.) GeV

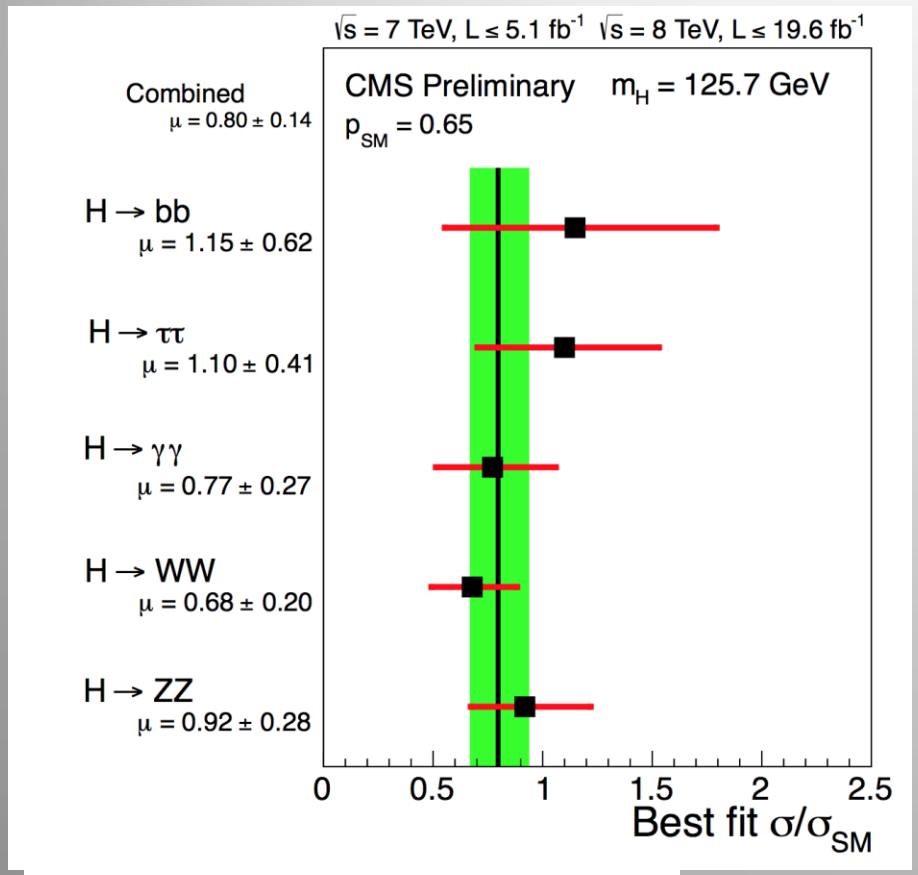


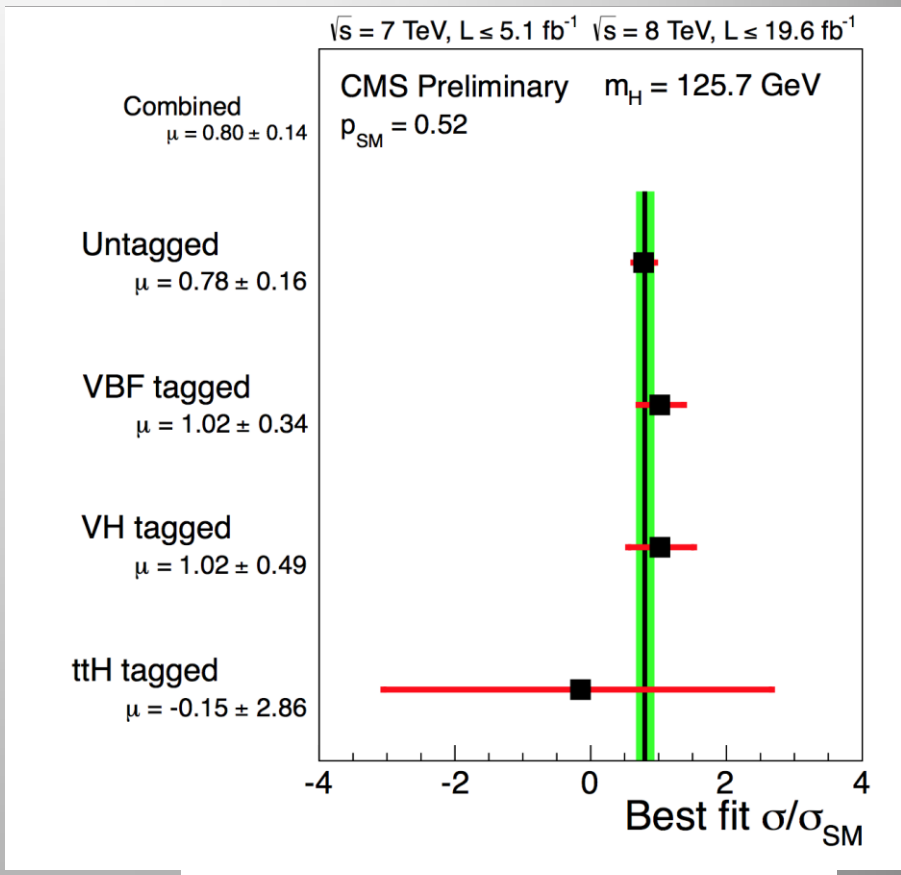


$m_H = 125.7 \pm 0.3^{(stat)} \pm 0.3^{(syst)}$ GeV

$= 125.7 \pm 0.4$ GeV

Consistency with SM Hypothesis





p-value= 0.65 w.r.t. μ=1

p-value= 0.52 w.r.t. μ=1

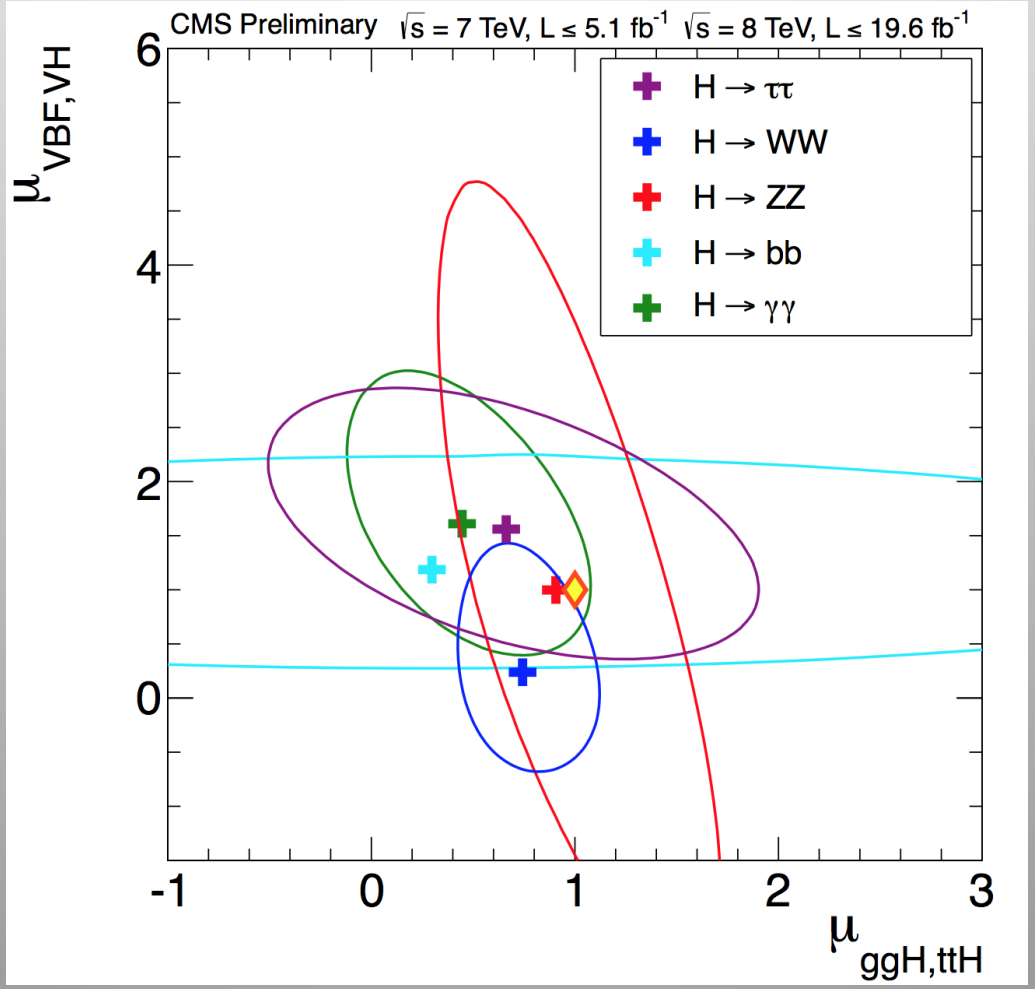
Combined signal strength: μ=0.80±0.14

Here and further: bb results based on 12 fb^{-1} at 8 TeV and 5 fb^{-1} at 7 TeV

Consistency with SM Hypothesis

2-dimensional view: test production modes in the various decay modes

Vector Boson Couplings

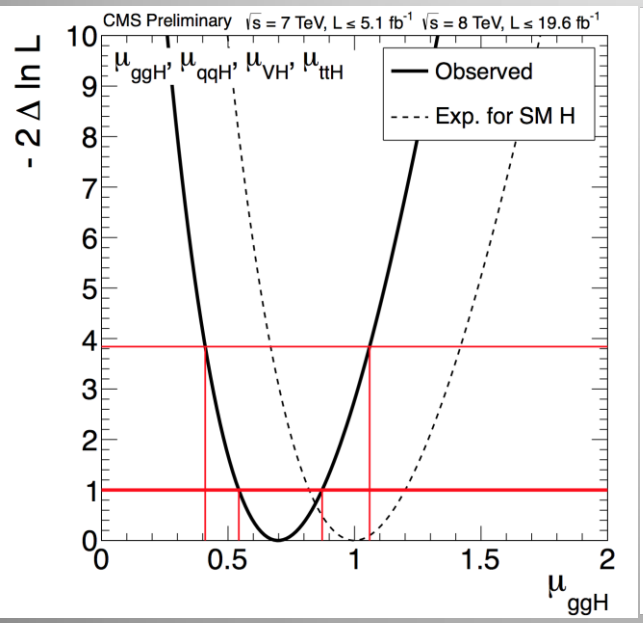


Fermion Couplings

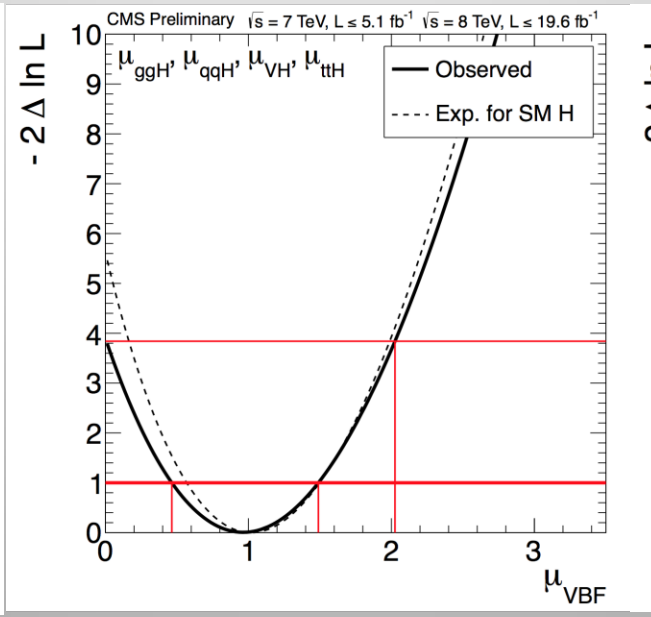
Signal Strength for Different Modes

Likelihood scans versus the different μ values, using all decay modes

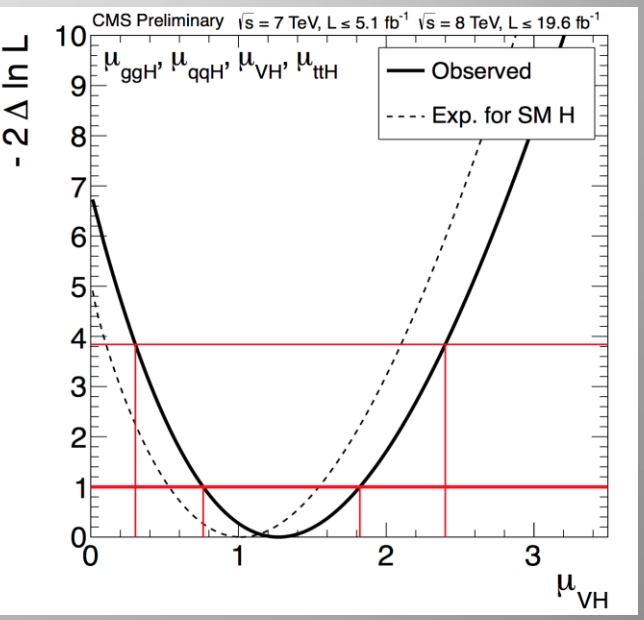
Gluon Gluon Fusion



Vector Boson Fusion



Associated production



Data in good agreement with the expectation

Approximately a 2σsignificance for the VBF channel

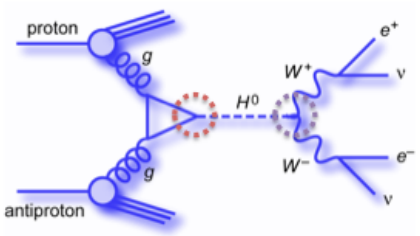
Couplings to Fermions and Bosons

Couplings scaled by κ_X:

Hff: κ_f *HVV:* κ_V

HWW: κ_W $\lambda_{WZ} = \kappa_W / \kappa_Z$

HZZ: κ_Z *In SM,* $\kappa_X = 1$

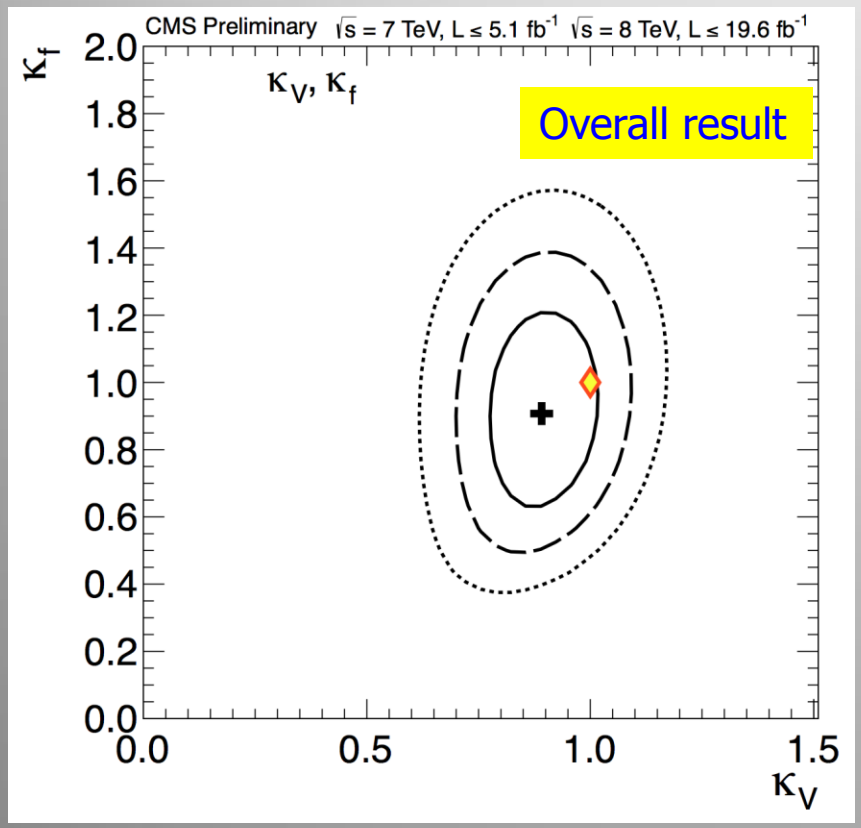


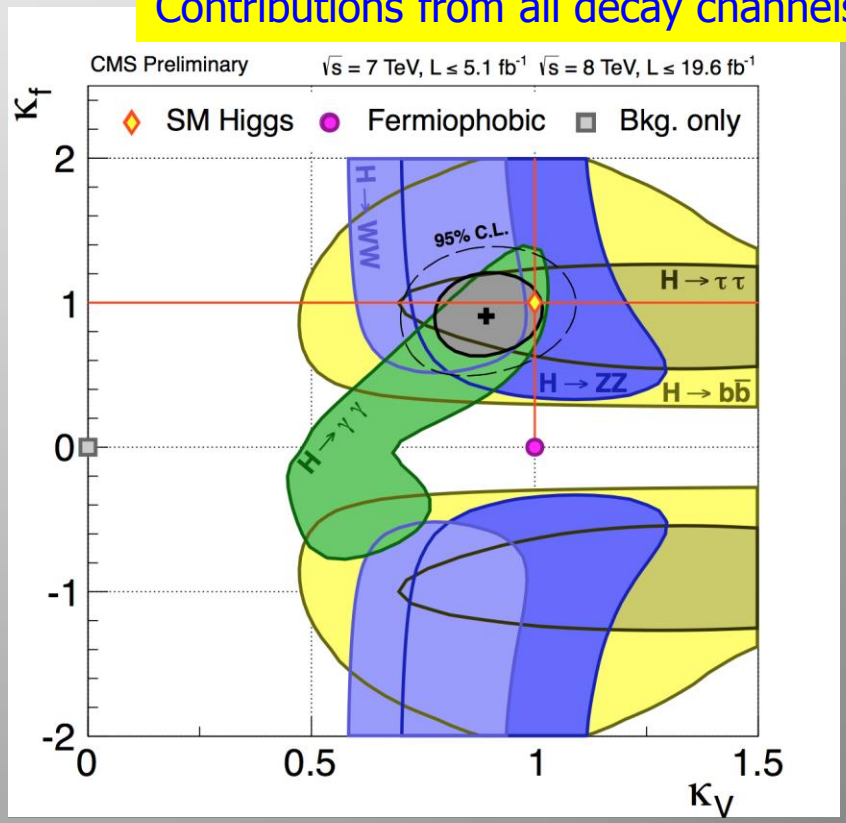
For $m_H = 125.7$ GeV

$\Gamma(H \rightarrow \gamma\gamma) \sim |\alpha\, \kappa_V + \beta\, \kappa_f|^2$

$\alpha/\beta = -0.2$, $\Gamma_{BSM} = 0$

Contributions from all decay channels



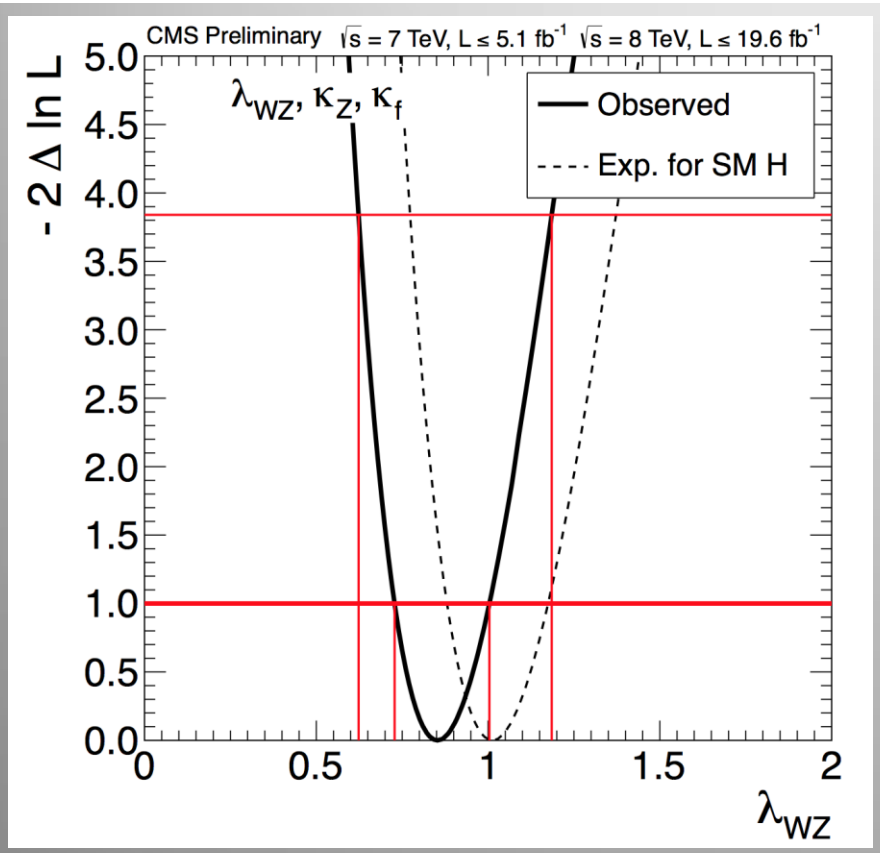


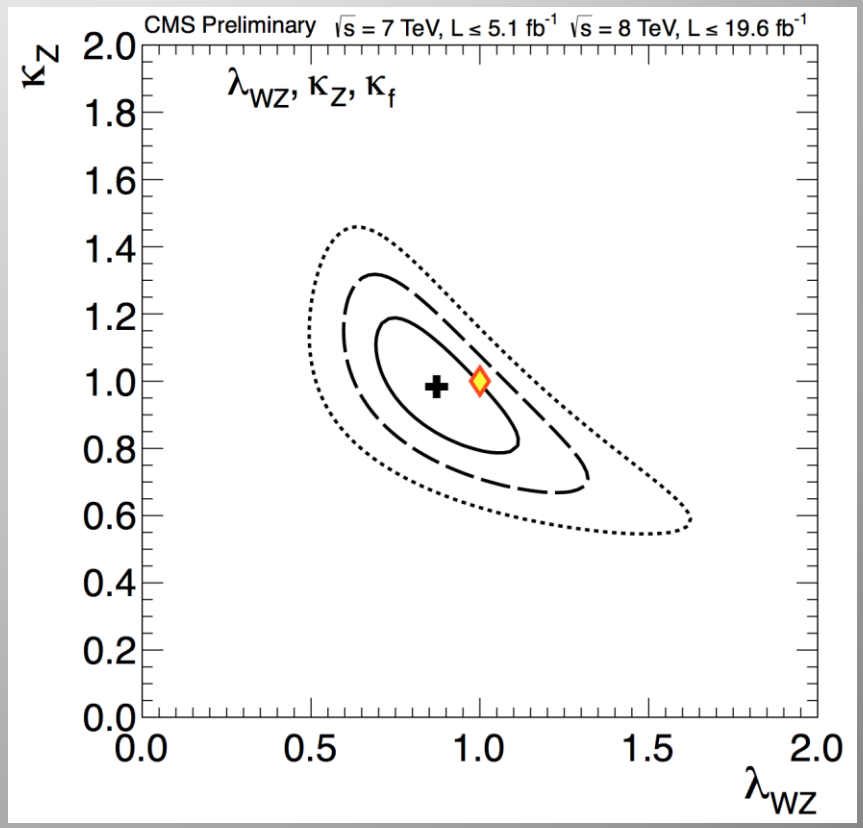
Results within 1σ of the Standard Model Prediction

Custodial Symmetry Test

Modify the SM Higgs boson couplings to the W and Z bosons introducing two scaling factors κ_W and κ_Z and perform combinations to assess if

$\lambda_{WZ} = \kappa_W/\kappa_Z = 1$ for $m_H = 125.7$ GeV



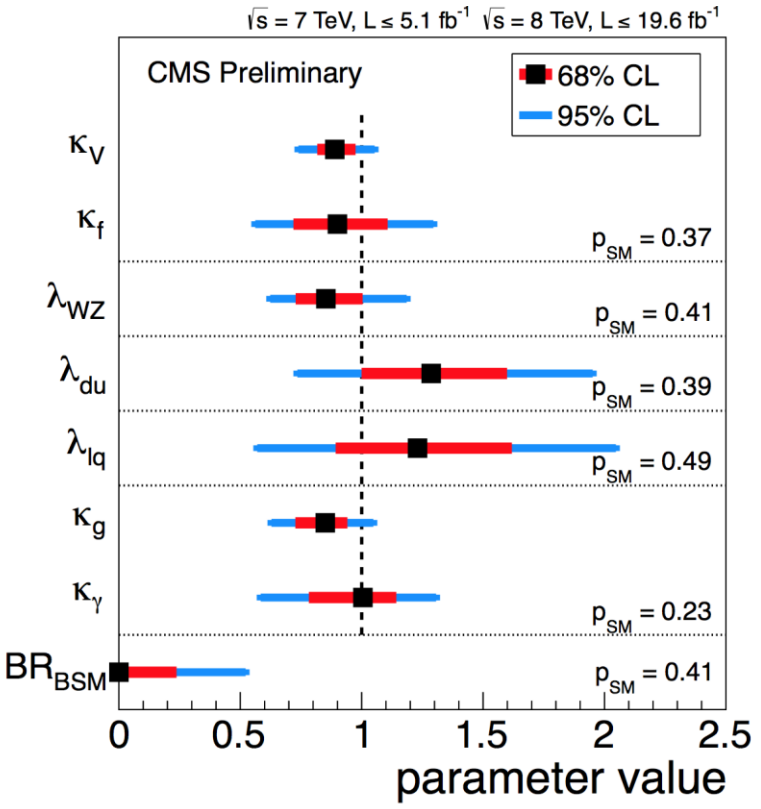


95% CL interval for λ_{WZ} : [0.62,1.19]

Summary of the Couplings Test

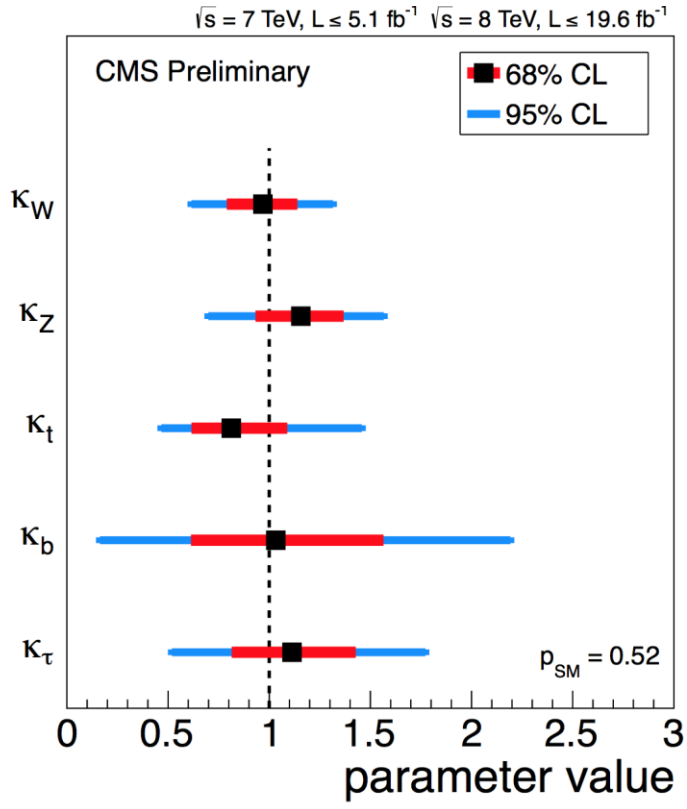
Summary of the fits for deviations in the couplings

for a LHC XS WG benchmark model parametrisation (arXiv:1209.0040)



ΓBSM = 0

for a generic five parameter model (no eff. loop couplings)



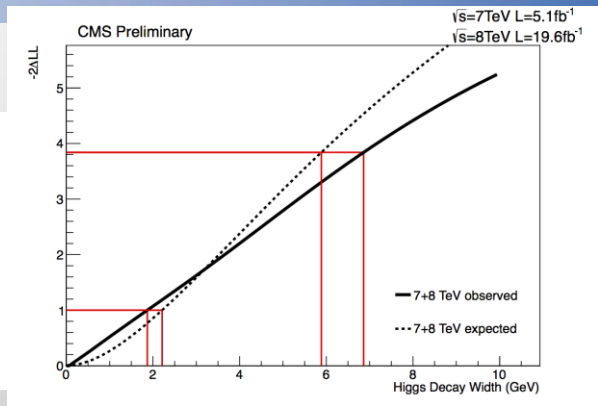
The best fit values of the most interesting parameters are shown, with the corresponding 68% and 95% CL intervals, and the overall p-value p_{SM} of the SM Higgs hypothesis is given.

Higgs Properties from H→γγ

CMS-PAS-HIG-13-016

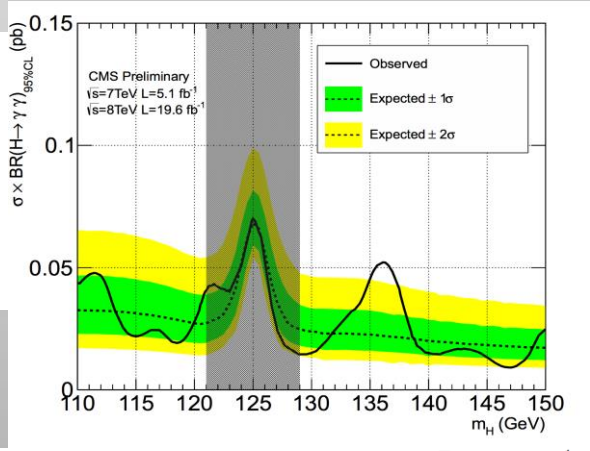
Upper limit on the Higgs width

- Dominated by experimental resolution
- Breit-Wigner + Gaussian fit
- Observed (exp) upper limit = 6.9 (5.9) GeV 95% CL



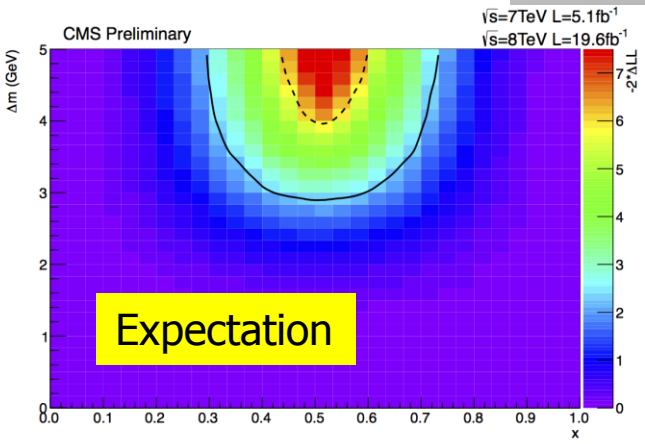
Additional Higgs-like states:

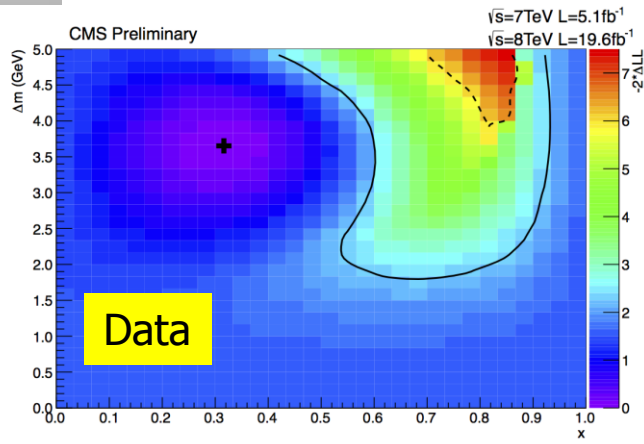
- Take SM 125 GeV as part of the background
- Search for additional Higgses
- Largest excess: 136.5 GeV with 2.9σ (<2σ after LEE)



Search for near mass degenerate states

- Two signals with relative strength x mass difference Δm
- Perform a 2D scan
- No signal at 95% CL for Δm> 4 GeV

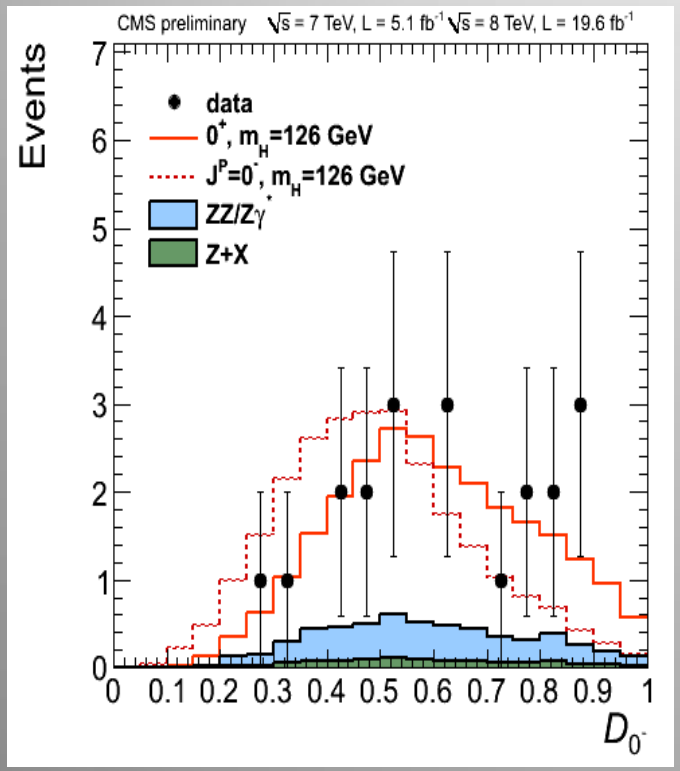


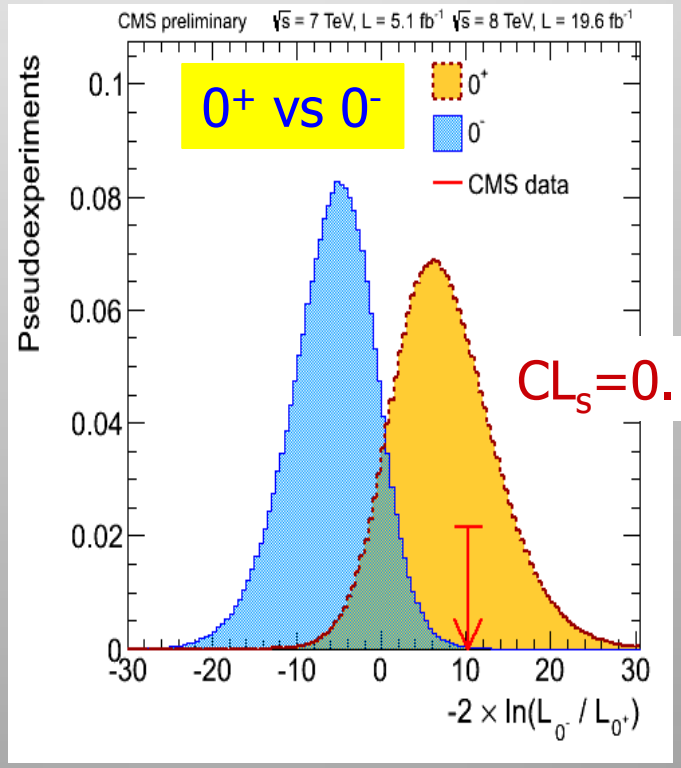


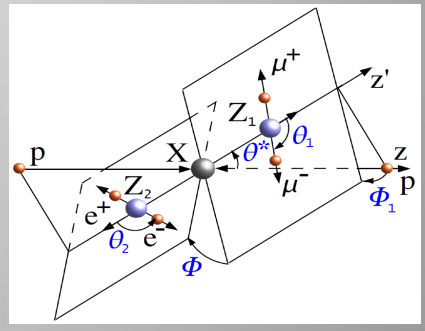
Spin/Parity Hypothesis Tests

Spin/parity hypothesis tests: $H \rightarrow ZZ \rightarrow 4l$ channel

Kinematic discriminant built to describe the kinematics of production and decay of different J^P state of a "Higgs"







J^P	CL_s
0^-	0.16%
0_h^+	8.1%
2^+_{mgg}	1.5%
$2^+_{mq\bar{q}}$	<0.1%
1^-	<0.1%
1^+	<0.1%

More J^P hypotheses have been tested in a similar way →

Spin Combination for $0^+/2^+_{mgg}$ Test

Combining results from WW and ZZ channel

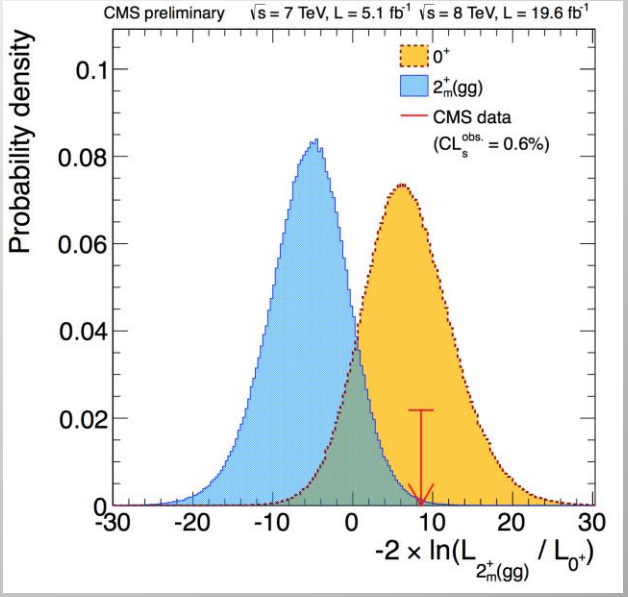
- Expected results with μ=1

ZZ	WW	Comb
6.8%	1.4%	0.2%

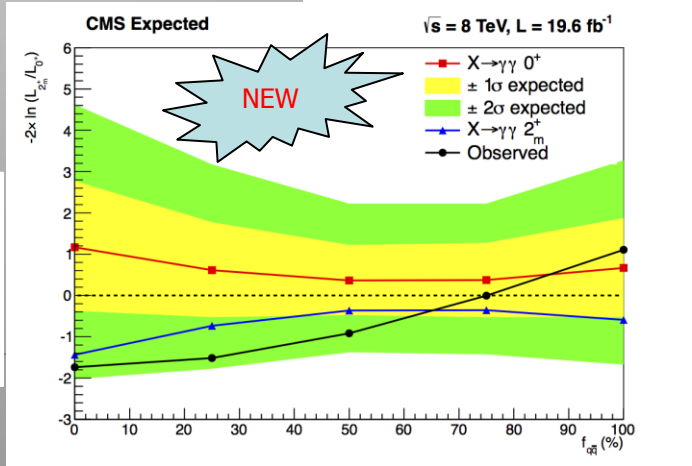
- Observed results at measured μ

ZZ	WW	Comb
1.4%	14%	0.6%

The observation is very compatible with the SM Higgs expectations of 0^+.
The data disfavours the $2^+_m(gg)$ hypothesis with a CLs value of 0.6%



CMS-PAS-HIG-12-016



Use the $\gamma\gamma$ events to distinguish $0^+/2^+_{mgg}$
The present $\gamma\gamma$ data does not have the power for a significant hypothesis test

Conclusions

- The discovery of the new particle last summer has been confirmed with more added collisions. Moving on now to measuring properties.
- The spin/parity is compatible with a 0^+ state and not with (simple) 0^- or spin 2 states
- The mass is getting measured better with time, the present value by CMS is 125.7 ± 0.4 GeV
- Signs of decays into fermion decay channels. The significance of the combined τ+b channels is $>3\sigma$
- Hunt for rare decays & processes is going on…
- The couplings to bosons and fermions are consistent with SM predictions, but these are tested so far up to ~20-30% precision only; Surprises still possible!!

14 March 2013

ISSUES AND EXPERTS

Higgs boson and new pope confirmed

March 14, 2013

Tweet Facebook Email Print

'God particle' is for real

Scientists are confirming that a new subatomic particle discovered at the world's most powerful particle accelerator is indeed an elusive Higgs boson, also referred to as 'the God particle.' It was discovered during experiments at the Large Hadron Collider (LHC) at CERN, Switzerland last July. Scientists, who say they have a "long way to go" to know what kind of Higgs boson it is, are reporting the confirmation at the Moriond physics conference in Italy this week. The

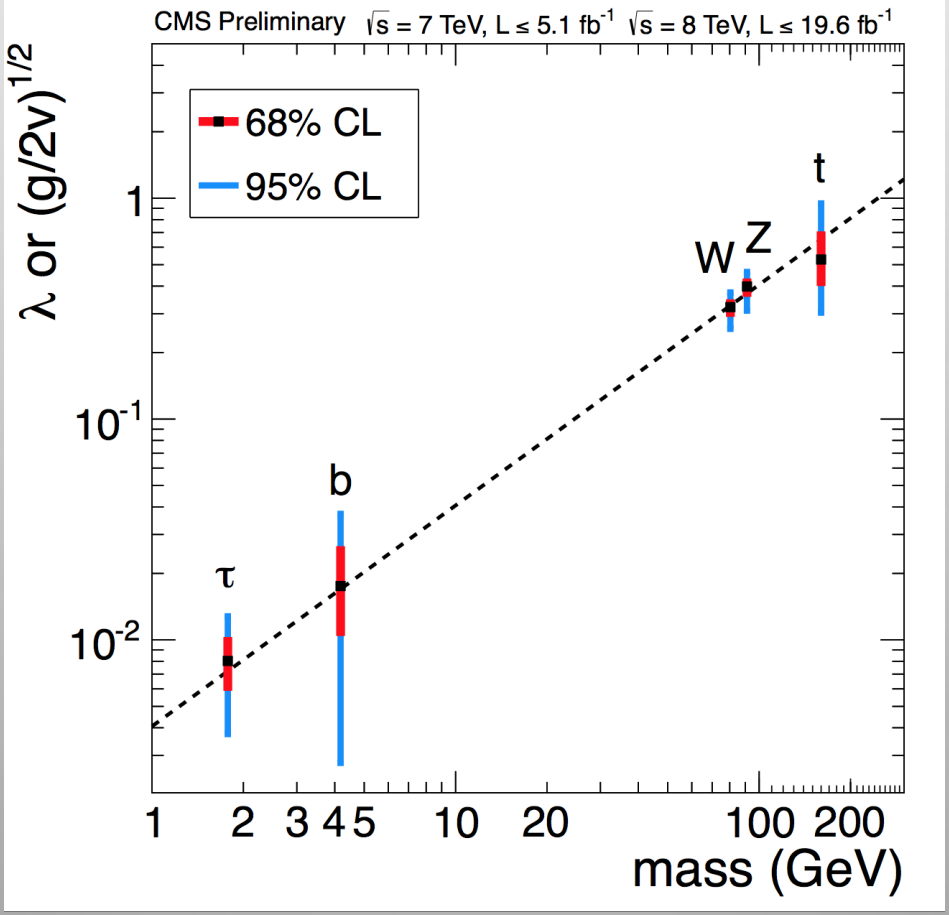
SFU SIMON FRASER UNIVERSITY
PUBLIC AFFAIRS AND MEDIA RELATIONS

The Pope and Higgs Boson: Too Much God to Digest all at Once?

Posted on March 15, 2013

Backup

Summary of the Couplings Test



For the fermions, the values of the fitted yukawa couplings are shown, while for vector bosons the square-root of the coupling for the hVV vertex divided by twice the vacuum expectation value of the Higgs boson field.

Decay	CMS Expected	CMS Observed	ATLAS Expected	ATLAS Observed
ZZ	7.1 σ	6.7 σ	4.4 σ	6.6 σ
γγ	3.9 σ	3.2 σ	4.1 σ	7.4 σ
WW	5.3 σ	3.9 σ	3.7 σ	3.8 σ
bb	2.2 σ	2.0 σ	1.0 σ	-0.4 σ
ττ	2.6 σ	2.8 σ	1.7 σ	1.1 σ

Comparisons based on pre-LP2013 data released by ATLAS and CMS

CMS: Mass = 125.7 GeV

ATLAS: Mass = 125 GeV (ZZ Mass= 124.3 GeV; γγ Mass = 126.8 GeV)

JP	CL_S (CMS)	CL_S (ATLAS)
0-	0.0016	0.022
0h+	0.081	-
1-	0.015	0.168
1+	<0.001	-
2mgg+	<0.001	0.060
2mqq	<0.001	0.002
2-	-	0.258

Comparisons based on pre-LP2013 data released by ATLAS and CMS

Decay	ATLAS M_H	ATLAS stat.	ATLAS syst	CMS M_H	CMS stat	CMS syst.
ZZ	124.3	0.5	0.3	125.8	0.5	0.2
γ γ	126.8	0.2	0.7	125.4	0.5	0.6
Comb.	125.5	0.2	0.5	125.7	0.3	0.3

Comparisons based on pre-LP2013 data released by ATLAS and CMS