

The background of the slide features a silhouette of a sprinter in a starting crouch on a track, with several curved lines representing the track's lanes. The overall color scheme is a gradient of orange and red.

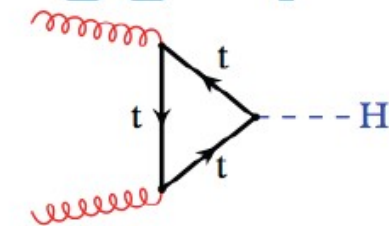
HIGGS NEWS

***CERN CMS-ATLAS seminar
Dec 13, 2011***

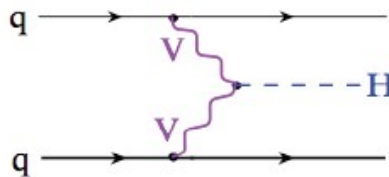


SM Higgs production at LHC

□ **Gluon fusion**



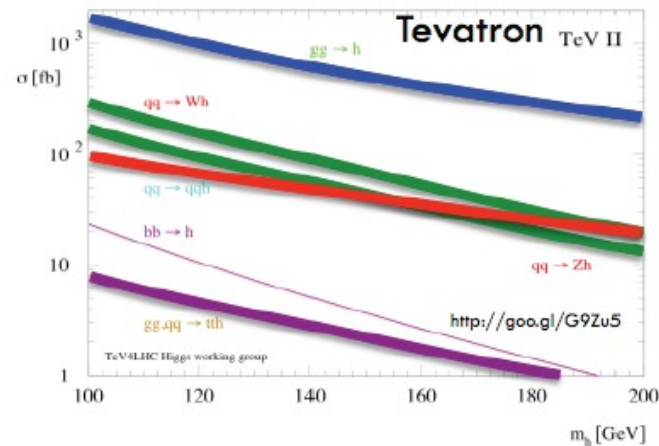
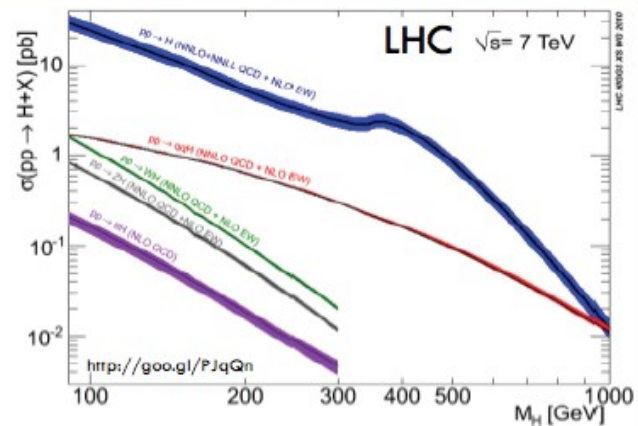
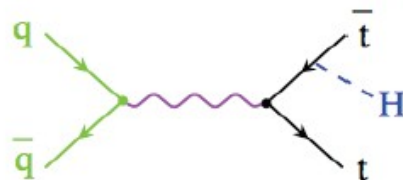
□ **VBF**



□ **VH**



□ **ttH**



Gluon fusion ($gg \rightarrow H$) is the dominant production mechanism at LHC.
 Irreducible backgrounds in $H \rightarrow WW, ZZ, \gamma\gamma$ are from qq annihilation. Signal to Noise better than at Tevatron except in VH . **VBF and VH also very useful at LHC**

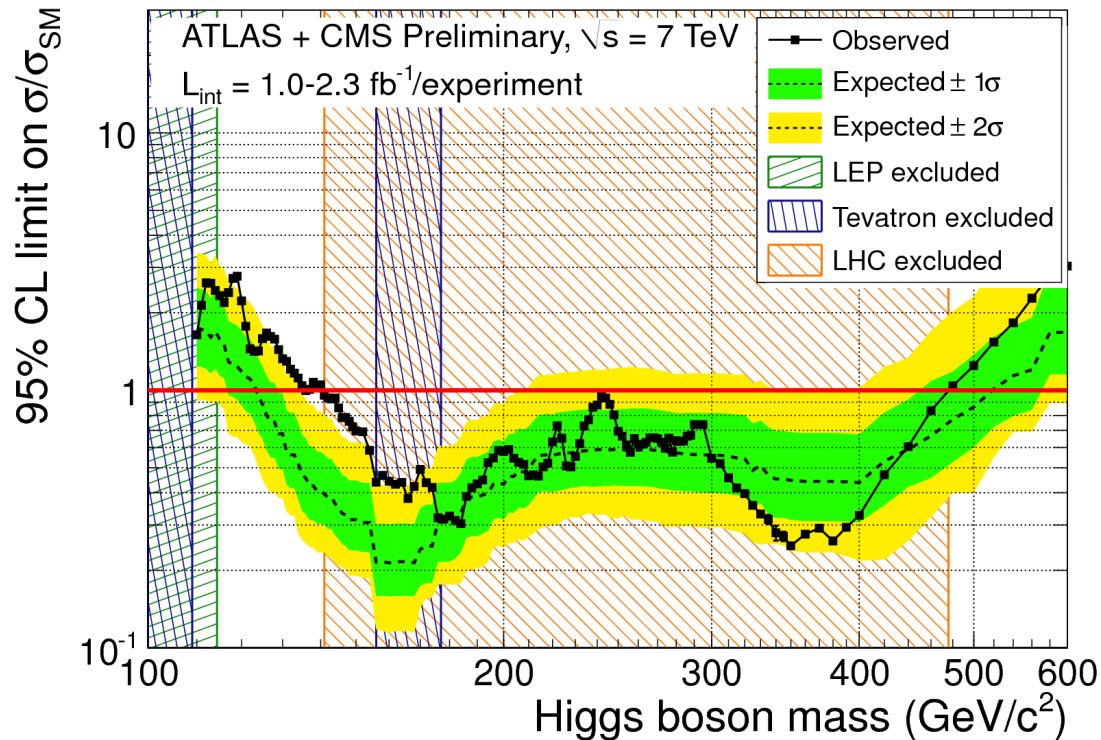


Analyses presented here

Channel	m_H range (GeV/ c^2)	Lumi (fb $^{-1}$)	sub- channels	m_H reso- lution
$H \rightarrow \gamma\gamma$	110 – 150	4.7	4	1–3%
$H \rightarrow \tau\tau$	110 – 145	4.6	9	20%
$H \rightarrow bb$	110 – 135	4.7	5	10%
$H \rightarrow WW \rightarrow l\nu l\nu$	110 – 600	4.6	5	20%
$H \rightarrow ZZ \rightarrow 4l$	110 – 600	4.7	3	1–2%
$H \rightarrow ZZ \rightarrow 2l2\tau$	190 – 600	4.7	8	10–15%
$H \rightarrow ZZ \rightarrow 2l2\nu$	250 – 600	4.6	2	7%
$H \rightarrow ZZ \rightarrow 2l2q$	$\left\{ \begin{array}{l} 130 - 164 \\ 200 - 600 \end{array} \right.$	4.6	6	3%

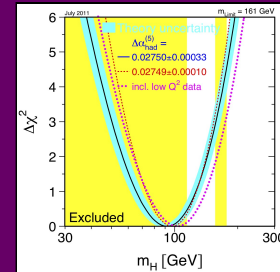
All 8 analyses yielded a preliminary result to be shown today, and contributed to the CMS combination documented in HIG-011-32.

Status on August 2011 combined CMS_ATLAS result



November 2011
 CMS PAS HIG-11-023,
 ATLAS-CONF-201-157

LEP (95%CL)
 $m_H > 114.4 \text{ GeV}$



Tevatron exclusion (95%CL):
 $100 < m_H < 109 \text{ GeV}$
 $156 < m_H < 177 \text{ GeV}$

First ATLAS+CMS combination: based on data recorded until end August 2011:
 up to $\sim 2.3 \text{ fb}^{-1}$ per experiment

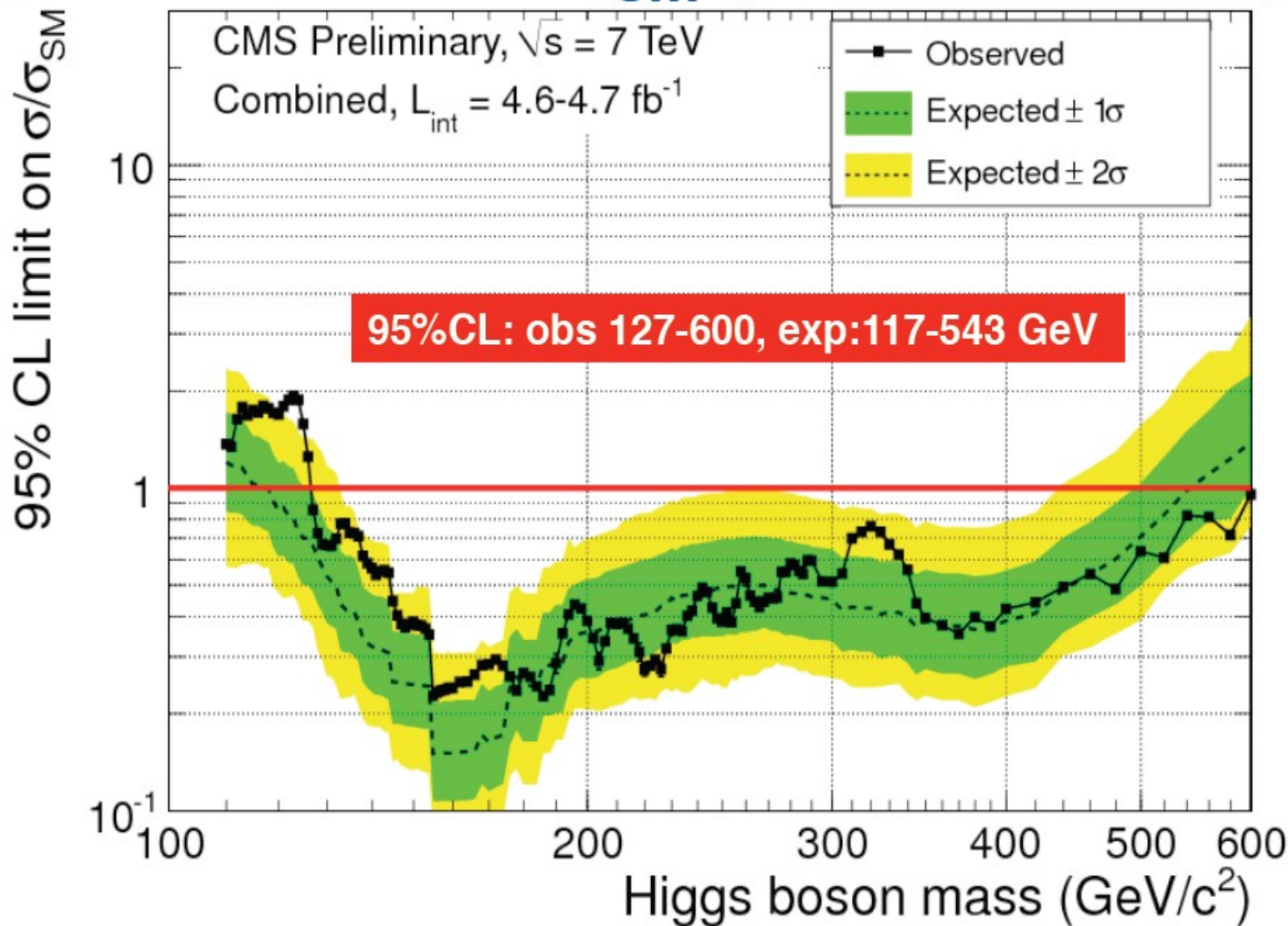
Excluded 95% CL : 141-476 GeV

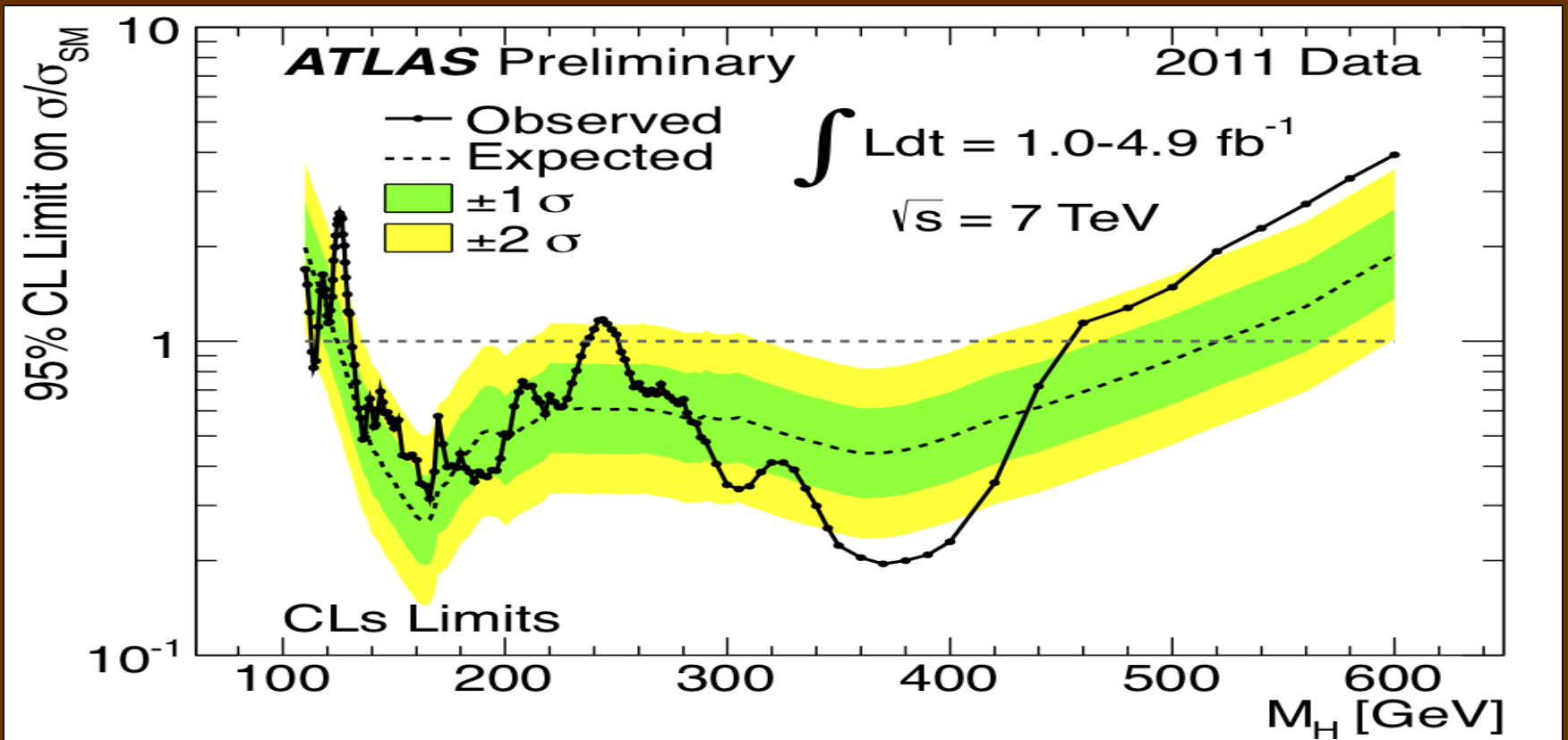
Excluded 99% CL : 146-443 GeV (except $\sim 222, 238-248, \sim 295 \text{ GeV}$)

Expected 95% CL : 124-520 GeV \rightarrow max deviation from background-only: $\sim 3\sigma$ ($m_H \sim 144 \text{ GeV}$)



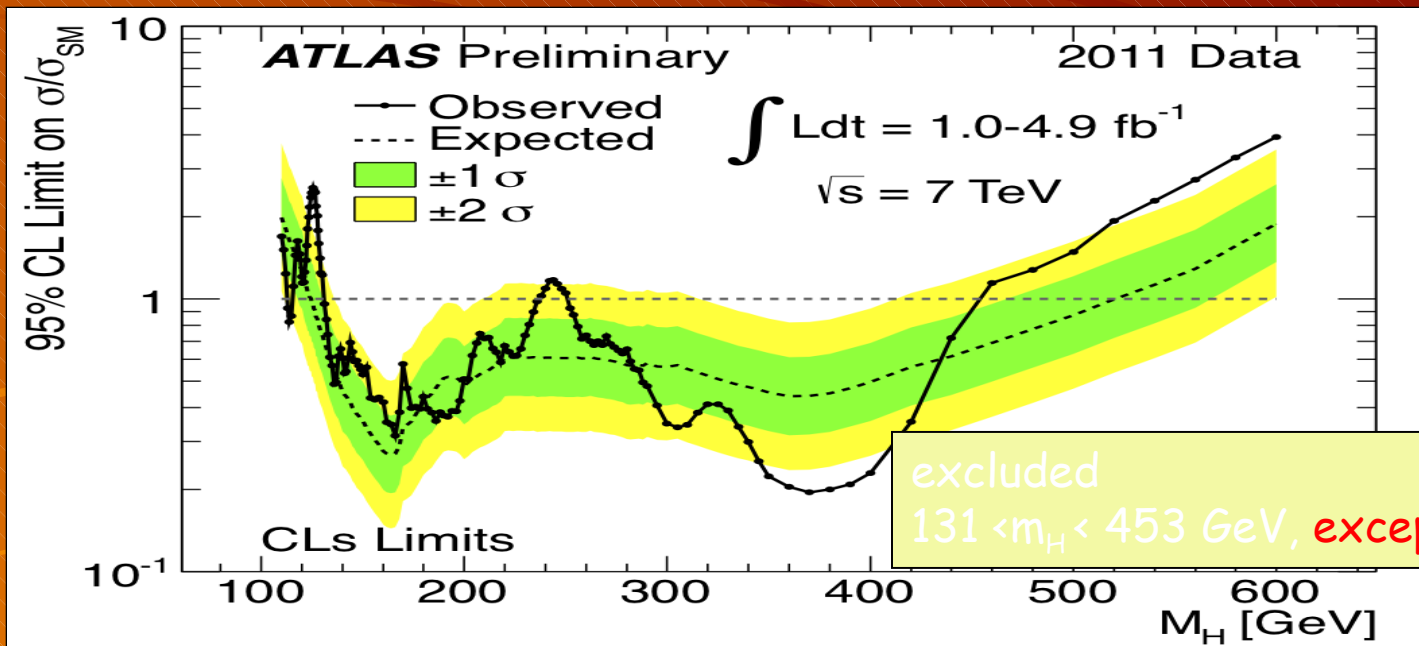
Limits on σ/σ_{SM} (CLs method)



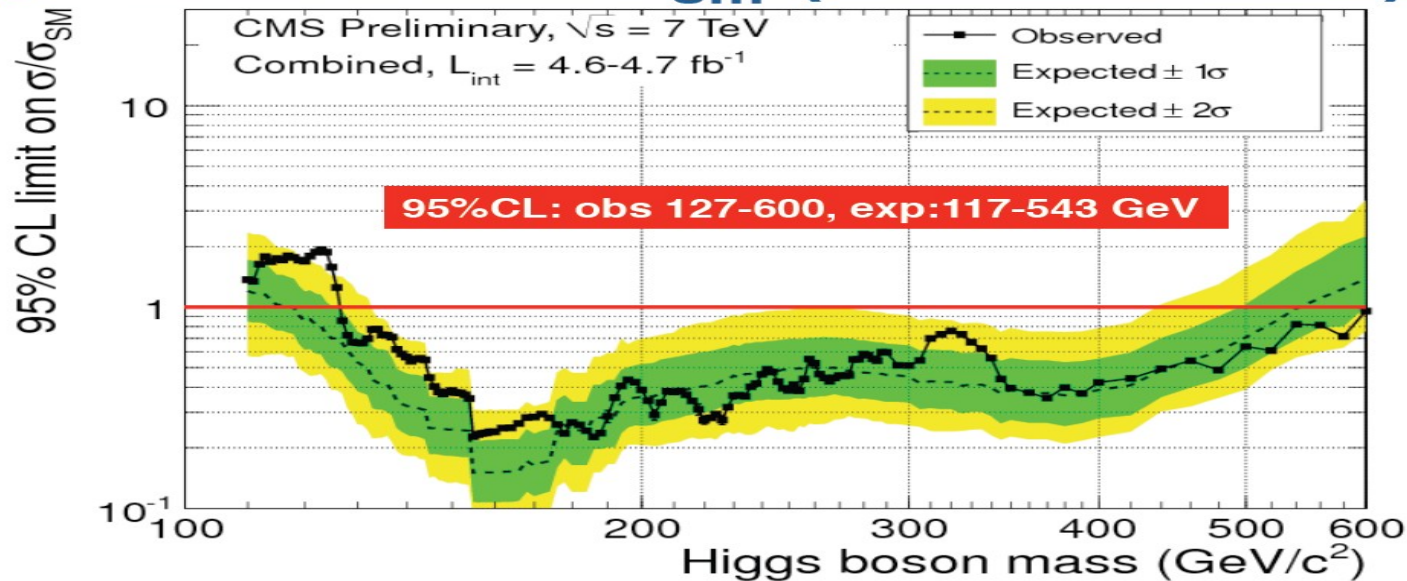


Excluded at 95% CL

$131 < m_H < 453 \text{ GeV}$, **except 237-251 GeV**

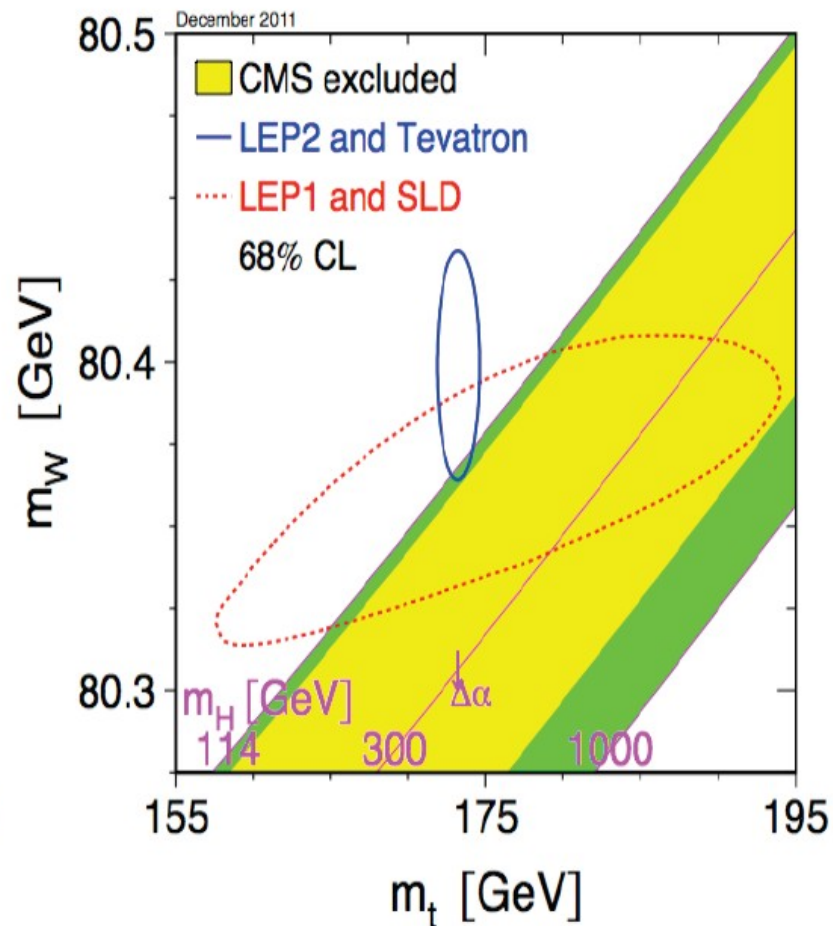
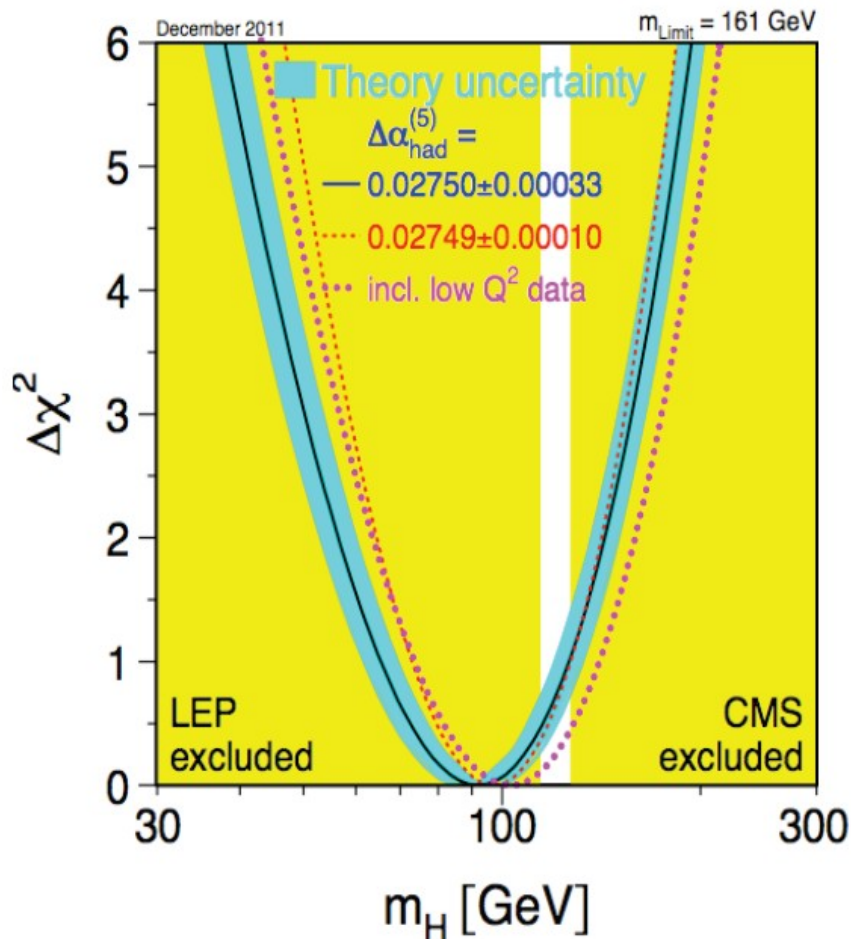


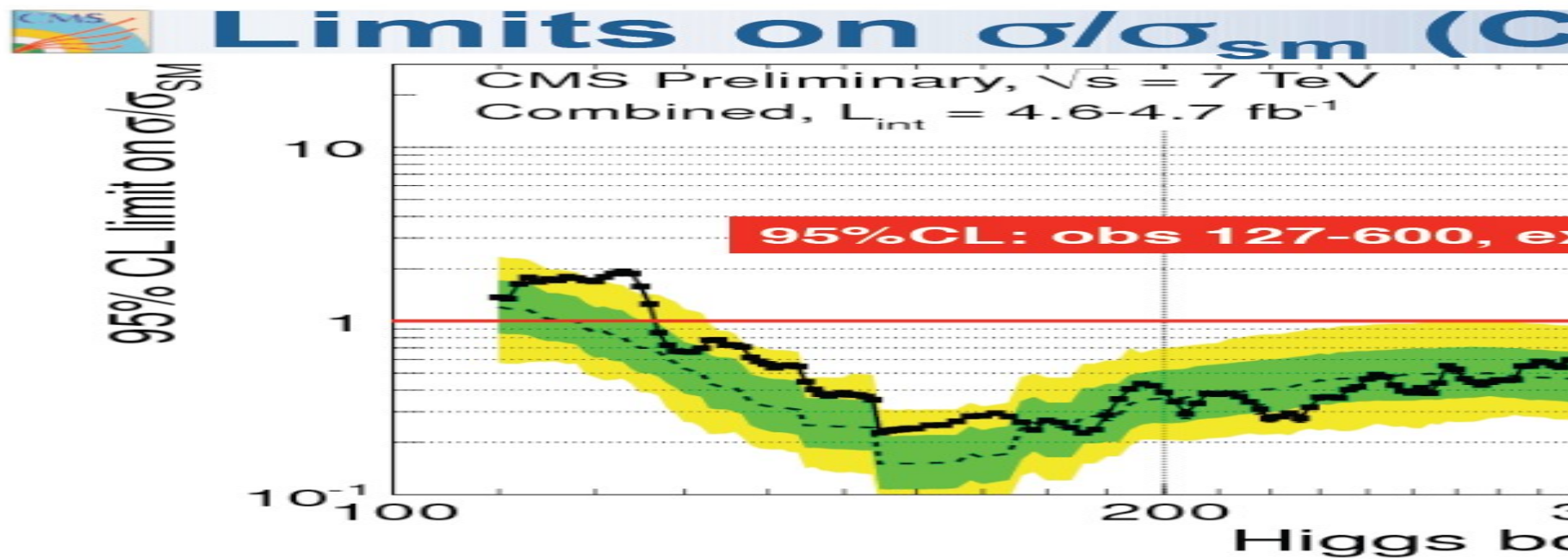
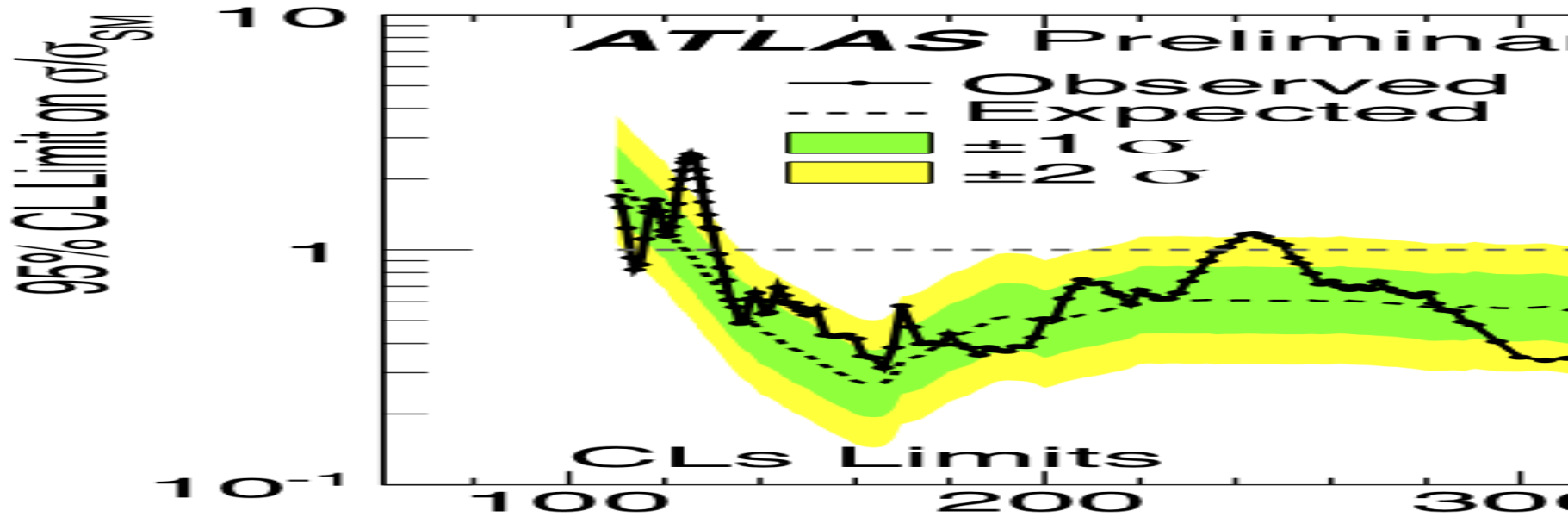
Limits on σ/σ_{sm} (CLs method)



Higgs is excluded in 127-543 GeV mass region

Freshly squeezed EWK plots



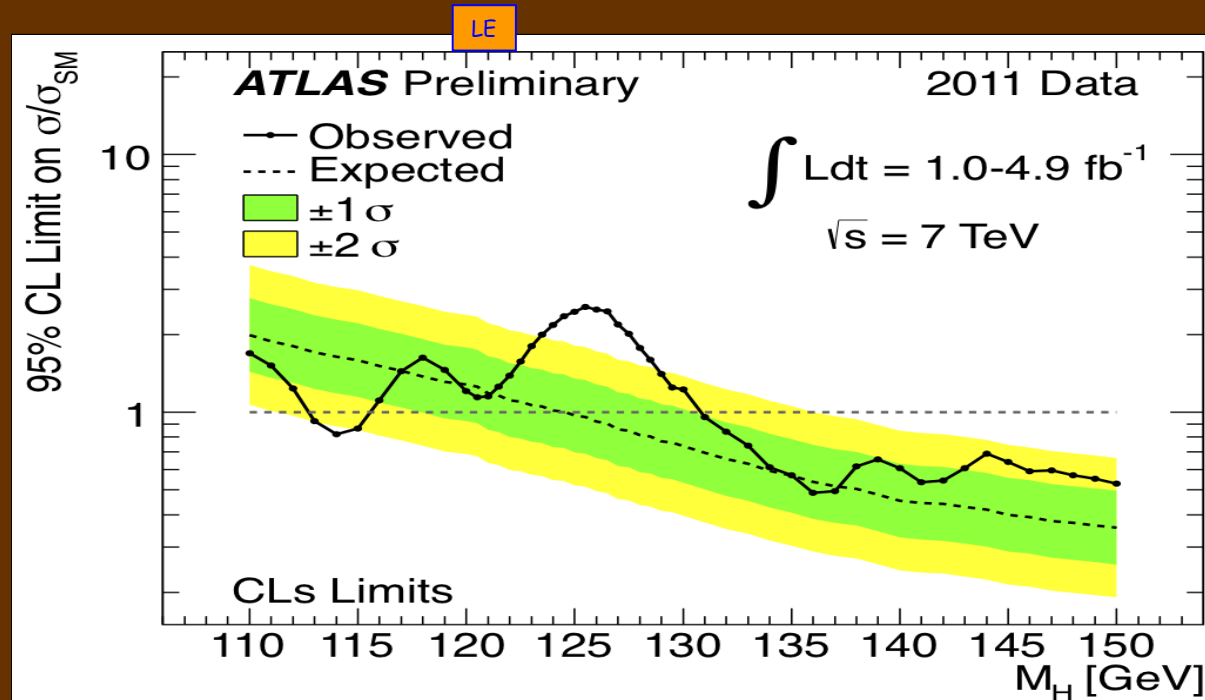


Micro-summary of present Higgs searches in ATLAS

Channel	m_H range (GeV)	Int. lumi fb^{-1}	Main backgrounds	Number of signal events after cuts	S/B after cuts	Expected σ/σ_{SM} sensitivity
$H \rightarrow \gamma\gamma$	110-150	4.9	$\gamma\gamma, \gamma j, jj$	~ 70	~ 0.02	1.6-2
$H \rightarrow \tau\tau \rightarrow ll+\nu$	110-140	1.1	$Z \rightarrow \tau\tau, \text{top}$	~ 0.8	~ 0.02	30-60
$H \rightarrow \tau\tau \rightarrow l\tau_{\text{had}}$	100-150	1.1	$Z \rightarrow \tau\tau$	~ 10	$\sim 5 \cdot 10^{-3}$	10-25
$W/ZH \rightarrow bbl(l)$	110-130	1.1	$W/Z+\text{jets}, \text{top}$	~ 6	$\sim 5 \cdot 10^{-3}$	15-25
$H \rightarrow WW^{(*)} \rightarrow l\nu l\nu$	110-300	2.1	$WW, \text{top}, Z+\text{jet}$	~ 20 (130 GeV)	~ 0.3	0.3-8
$H \rightarrow ZZ^{(*)} \rightarrow 4l$	110-600	4.8	ZZ^*, top, Zbb	~ 2.5 (130 GeV)	~ 1.5	0.7-10
$H \rightarrow ZZ \rightarrow ll\nu\nu$	200-600	2.1	$ZZ, \text{top}, Z+\text{jets}$	~ 20 (400 GeV)	~ 0.3	0.8-4
$H \rightarrow ZZ \rightarrow llqq$	200-600	2.1	$Z+\text{jets}, \text{top}$	2-20 (400 GeV)	0.05-0.5	2-6
$H \rightarrow WW \rightarrow l\nu qq$	240-600	1.1	$W+\text{jets}, \text{top}, \text{jets}$	~ 45 (400 GeV)	10^{-3}	5-10

ATLAS
today

$H \rightarrow \gamma\gamma$,
 $H \rightarrow WW^{(*)} \rightarrow l\nu l\nu$
 $H \rightarrow ZZ^{(*)} \rightarrow 4l$,



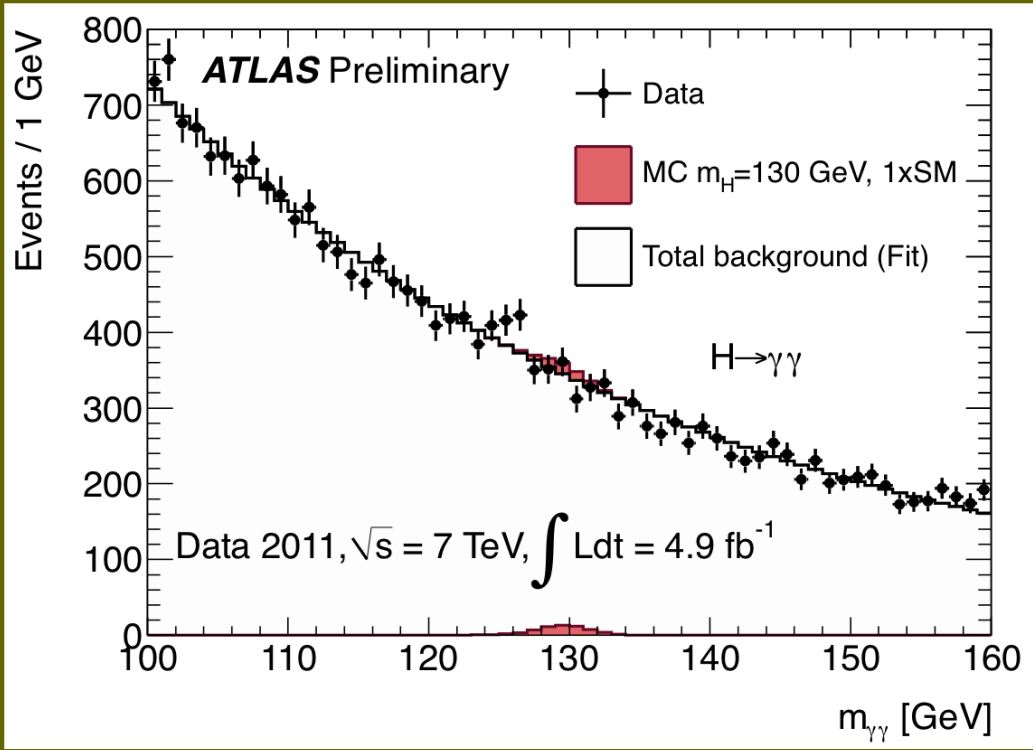
We observe an excess of events around $m_H \sim 126$ GeV:

local significance 3.6σ , with contributions from the

$H \rightarrow \gamma\gamma$ (2.8σ), $H \rightarrow ZZ^* \rightarrow 4l$ (2.1σ), $H \rightarrow WW^{(*)} \rightarrow l\nu l\nu$ (1.4σ)

the **global significance** (taking into account Look-Elsewhere-Effect) is **$\sim 2.3 \sigma$**

H → γγ

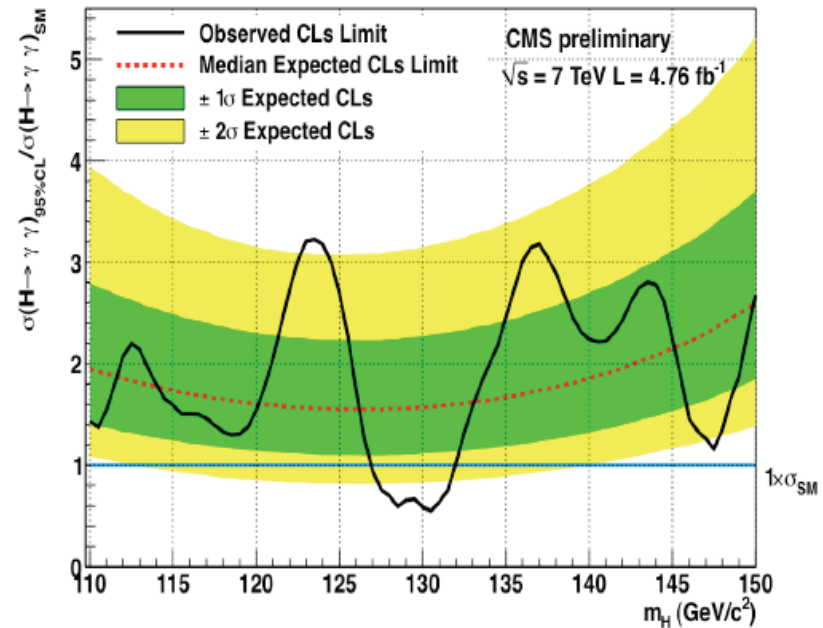
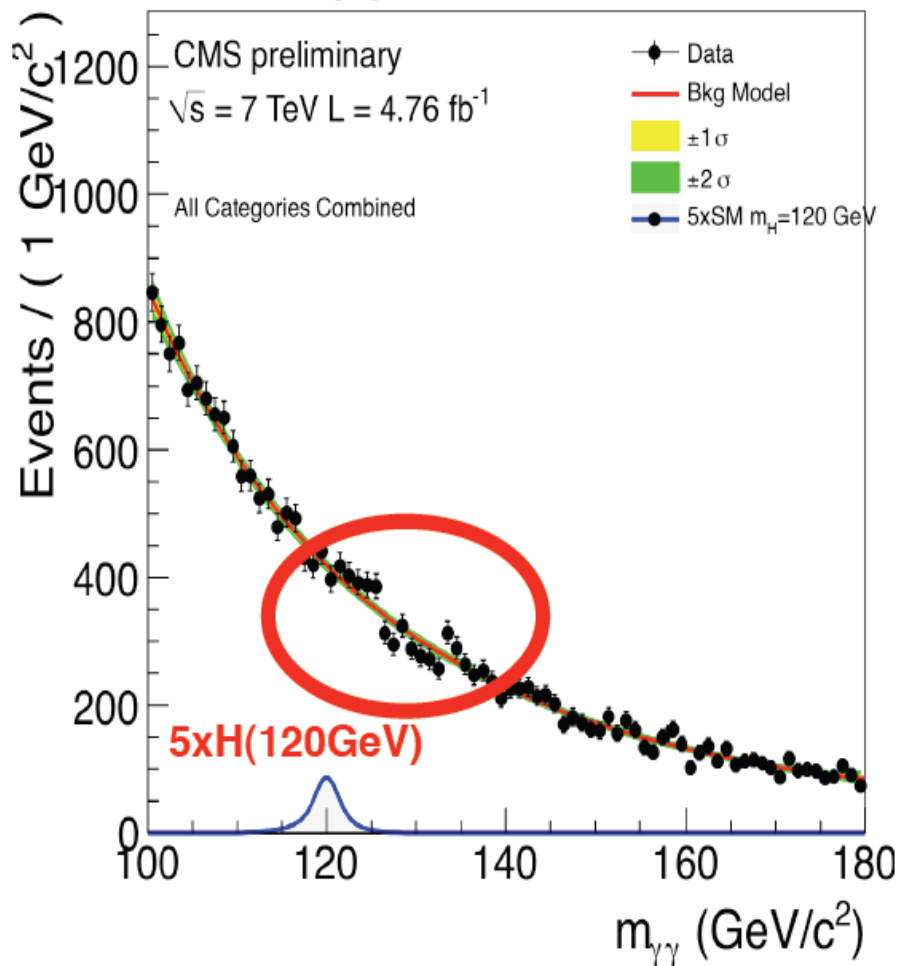


$m_H \sim 126$ GeV:

- ❑ Small cross-section: $\sigma \sim 40 \text{ fb}$
- ❑ Simple final state: two high- p_T isolated photons
 $E_T(\gamma_1, \gamma_2) > 40, 25 \text{ GeV}$
- ❑ Main background: $\gamma\gamma$ continuum (irreducible, smooth, ..)
- ❑ Events divided into 9 categories based on η -photon (e.g. central, rest, ...), converted/unconverted, $p_{T^{\gamma\gamma}}$ perpendicular to $\gamma\gamma$ thrust axis
- ❑ **~70 signal events** expected in 4.9 fb^{-1} after all selections for $m_H=125 \text{ GeV}$
- ❑ **~ 3000 background events** in signal mass window → $S/B \sim 0.02$



H → γγ: data and exclusion limits



A lot of studies on the background fit model. Is the structure/shape of the observed limit due to the chosen background model? No – this has been shown to not be the case.

Using 5th order polynomial fit to background: some loss in sensitivity but negligible bias.

Summaries

ATLAS@CMS

Исключено существование Хиггс-бозона с массой 127 – 600 ГэВ

ATLAS

We observe an excess of events around $m_H \sim 126$ GeV:

Local significance 3.6σ

Global significance $\sim 2.3 \sigma$

CMS

We are not able to exclude the presence of the SM Higgs below 127 GeV since we observe a modest excess of the events between 115 and 127 GeV. The excess is most compatible with a SM Higgs in the vicinity of 124 GeV and below. But the statistical significance is not large enough to say anything conclusive.

Local significance 2.6σ

Global significance 1.9σ