



ATLAS Results from Higgs searches. Update of $\gamma\gamma$ and 4ℓ channels with 13^{-1} fb

Run Num
Event Num
Date: 2012-06-10, 13:12:52 CET

EtCut>0.4 GeV
PtCut>1.0 GeV

Muon: blue
Cells: Tiles, EMC

Fernando G. Monticelli on behalf of the
ATLAS collaboration

UNLP/IFLP/CONICET

p0, signal strength

- **Diphoton :**

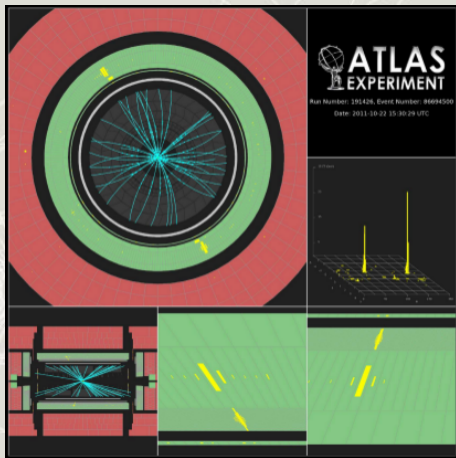
<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2012-168>

- **Four leptons :**

<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2012-169>

- **Combination :**

<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2012-170>

Update of $H \rightarrow \gamma\gamma$ 

Signal (SM_{126GeV})	S/B	Main backgrounds	Production	$\int L dt @ 7\&8 \text{ TeV}$
~ 220	3%-20%	$jj, \gamma j, \gamma\gamma$	ggH, VBF, VH	4.9 & 13 fb^{-1}

$H \rightarrow \gamma\gamma$

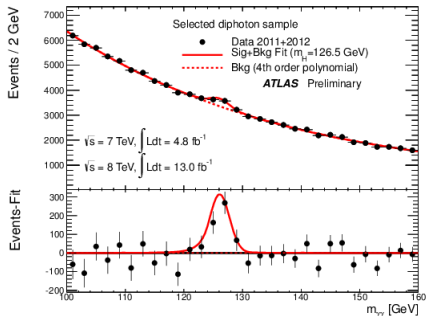
- Simple topology: two high- p_T isolated photons $ET(\gamma_1, \gamma_2) > 40, 30$ GeV

To increase sensitivity, overall and to specific production processes 12 exclusive categories:

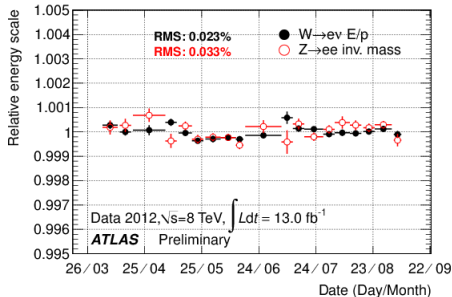
- γ rapidity, converted/unconverted γ , $p_T(p_T\gamma\gamma$ perpendicular to $\gamma\gamma$ "thrust" axis) presence of 2 high-mass ($m_{jj} > 400$ GeV) forward jets \rightarrow target VBF process

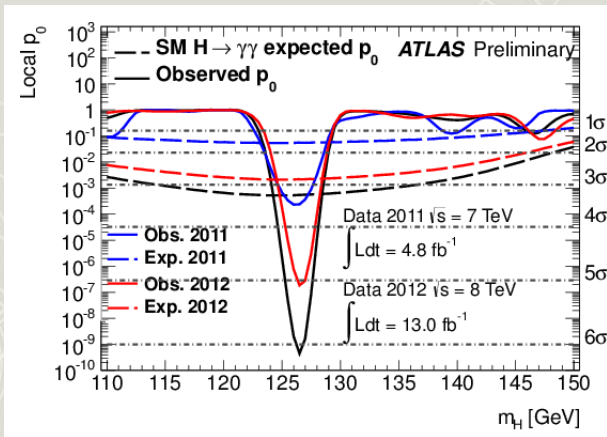
New:!

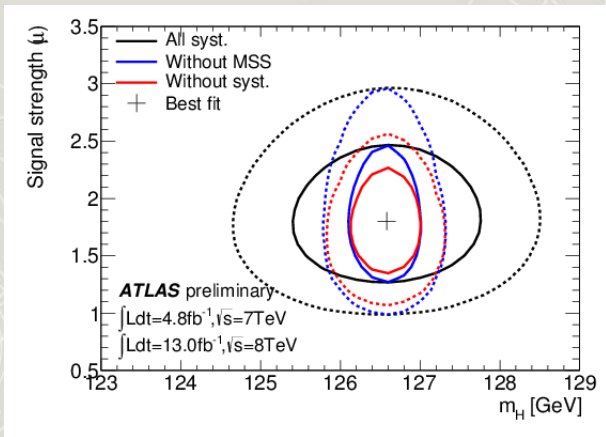
- 1 lepton \rightarrow target W/Z/ttH $\rightarrow l\gamma\gamma$ production
- Low-mass di-jet ($60 < m_{jj} < 100$ GeV) jets \rightarrow target W/ZH $\rightarrow jj\gamma\gamma$ production
 - Change in isolation and NN-based vertex finding algorithm



Stability vs time and pileup $< 0.1\%$



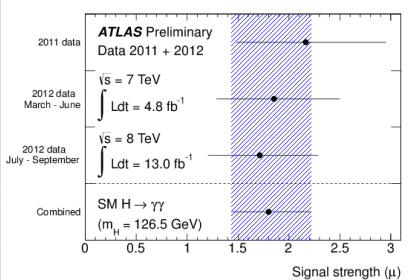
$H \rightarrow \gamma\gamma$ confirmation and Single channel discovery!Observed local
significance**6 σ** Expected local
significance**3.3 σ** 2011 126.0 GeV 3.5 σ (exp 1.6 σ)2012 127.0 GeV 5.1 σ (exp 2.9 σ)

$H \rightarrow \gamma\gamma$ Mass measurement

Measurement of the narrow resonance mass:

$$m_H = 126.6 \pm 0.3 \text{ (stat)} \pm 0.7 \text{ (syst)}$$

H \rightarrow $\gamma\gamma$ Signal strength



Measurement of signal strength

$$\hat{\mu} = 1.8 \pm 0.3 |_{(stat)} {}^{0.29} |_{(syst)}$$

2011	126.0 GeV	3.5 σ (exp. 1.6 σ)	$\mu = 2.2 \pm 0.7$
2012	127.0 GeV	5.1 σ (exp. 2.9 σ)	$\mu = 1.5 \pm 0.6$
All	126.5 GeV	6.1 σ (exp. 3.3 σ)	$\mu = 1.8 \pm 0.4$

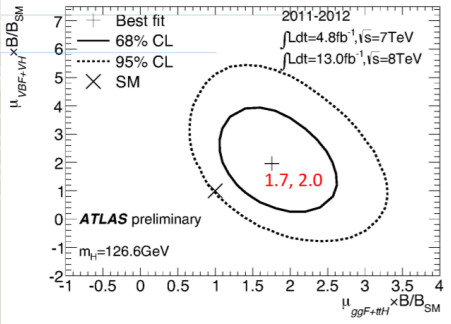
Fermion couplings dominated modes

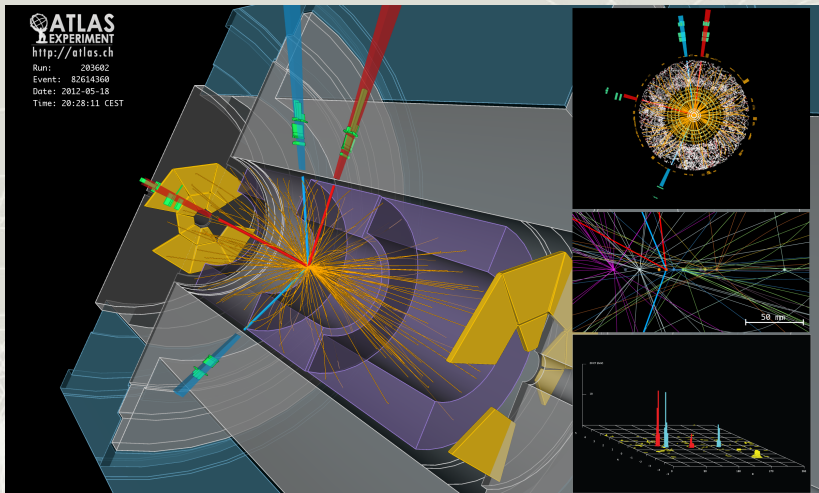
ggH+ttH



Vector boson dominated modes

VBF+VH





Signal/ fb^{-1}	S/B	Main backgrounds	Production	$\int L dt @ 7\&8 \text{ TeV}$
~ 1	~ 1	ZZ, Z+jets, top	inclusive	4.9 & 13 fb^{-1}

$$H \rightarrow ZZ^* \rightarrow 4\ell$$

Selection

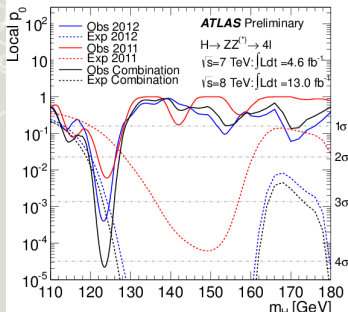
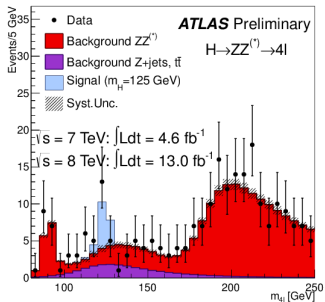
- $p_T^{1,2,3,4} > 20, 15, 10, 7$ GeV (6 GeV for μ)
- Leading di-lepton mass: $50 < m_{1,2} < 106$ GeV
- Subleading di-lepton mass: $m_{thr}(m_{4l}) < m_{34} < 115$ GeV ; $m_{thr} = 17.5 - 50$

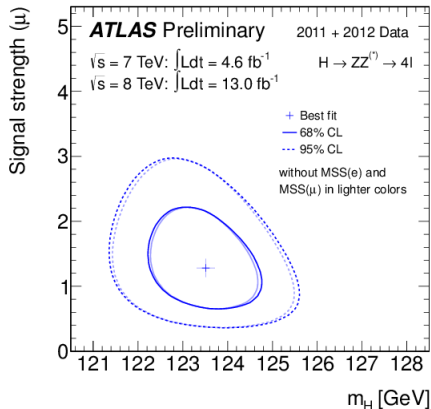
Events in the signal region (125 ± 5 GeV)

Observed	18 Events
Expected from bkg only	8.3 ± 0.8
Expected from SM Higgs	9.9 ± 1.3

Observed local significance	Expected local significance
-----------------------------	-----------------------------

4.1σ	3.1σ
-------------------------------	-------------



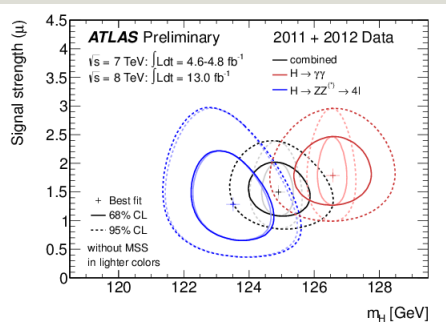
H \rightarrow 4 ℓ Mass and Signal Strength Measurements

Measurement of narrow resonance mass
 (profiling signal strength)

$$m_H = 123.5 \pm 0.9 \text{ (stat)} \begin{matrix} +0.4 \\ -0.2 \end{matrix} \text{ (syst)}$$

Measurement of signal strength
 (profiling the mass)

$$\hat{\mu} = 1.3 \pm 0.4$$

$H \rightarrow \gamma\gamma$ and $H \rightarrow 4\ell$ combination

Measurement signal strength
(at best signal strength)

$$\mu_H = 125.2 \pm 0.3 \text{ (stat)} \pm 0.6 \text{ (syst)}$$

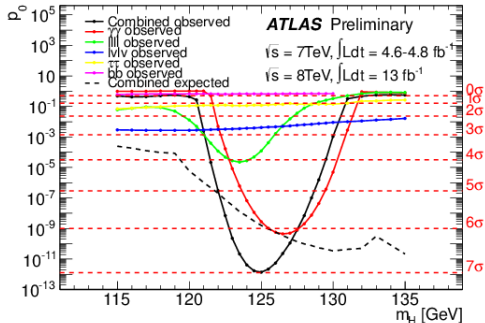
Measurement of signal strength
(at best mass fit 125.2)

$$\hat{\mu} = 1.35 \pm 0.19 \text{ (stat)} \pm 0.5 \text{ (syst)}$$

- Taking all MSS systematics uncertainties and their correlations into account, the compatibility of the two measurements is estimated to be at the 2.7σ level.
- An alternative of systematics uncertainties (more conservative) yields a compatibility at the level of 2.3σ level

Combination of all channels

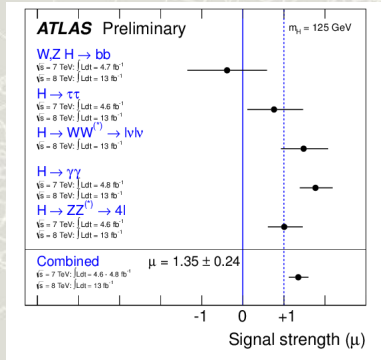
Updated with 13 fb⁻¹ of 2012 8 TeV data



Observed local significance
7.0 σ

Expected local significance
 5.9 σ

Summary of signal strength in all SM Higgs search channels



Overall agreement with SM Higgs Boson hypothesis