

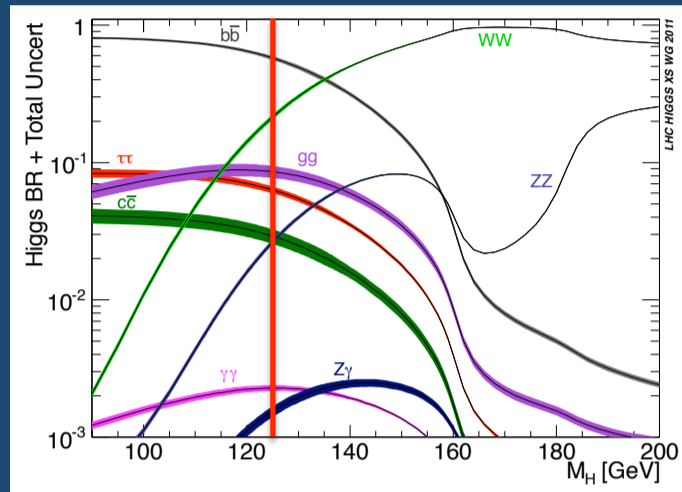


# LHCC Poster Session - CERN, 13 March 2013

## Combination of the searches for the low-mass Standard Model Higgs boson with ATLAS detector

- Update of the combined measurements of the mass and the signal strength value;
- Updated analyses for  $H \rightarrow \gamma\gamma$  and  $H \rightarrow ZZ^{(*)} \rightarrow 4l$  using up to  $4.8 \text{ fb}^{-1}$  of pp collision data at  $\sqrt{s} = 7 \text{ TeV}$  and  $20.7 \text{ fb}^{-1}$  at  $\sqrt{s} = 8 \text{ TeV}$ ;
- $H \rightarrow WW^{(*)} \rightarrow l\nu l\nu$  using up to  $13 \text{ fb}^{-1}$  of pp collision data at  $\sqrt{s} = 8 \text{ TeV}$ ,  $H \rightarrow \tau\tau$  and  $VH \rightarrow bb$  using up to  $4.7 \text{ fb}^{-1}$  of pp collision data at  $\sqrt{s} = 7 \text{ TeV}$  and  $13 \text{ fb}^{-1}$  at  $\sqrt{s} = 8 \text{ TeV}$ ;
- Several benchmarks are considered that are designed to probe different aspects of the Standard Model (SM) Higgs boson couplings. All measurements are consistent with the SM expectation.

### Higgs searches:

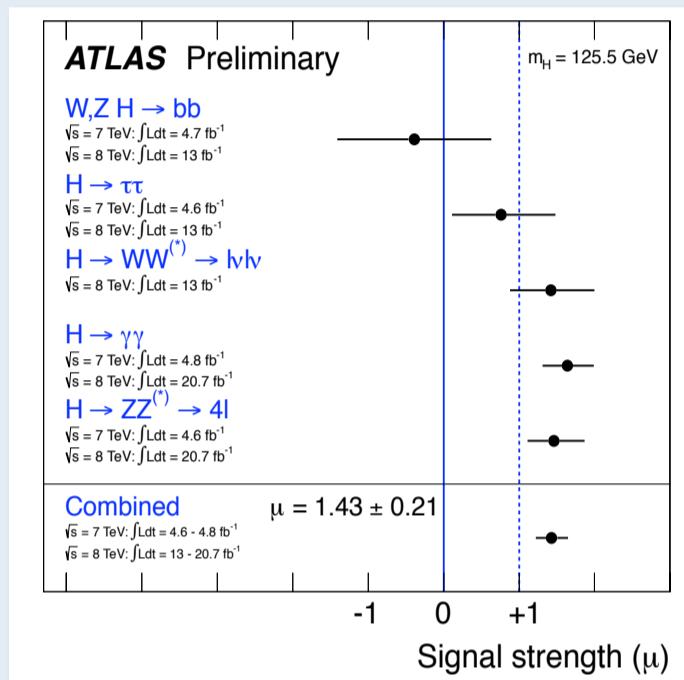


### Main Standard Model Higgs decays @125 GeV:

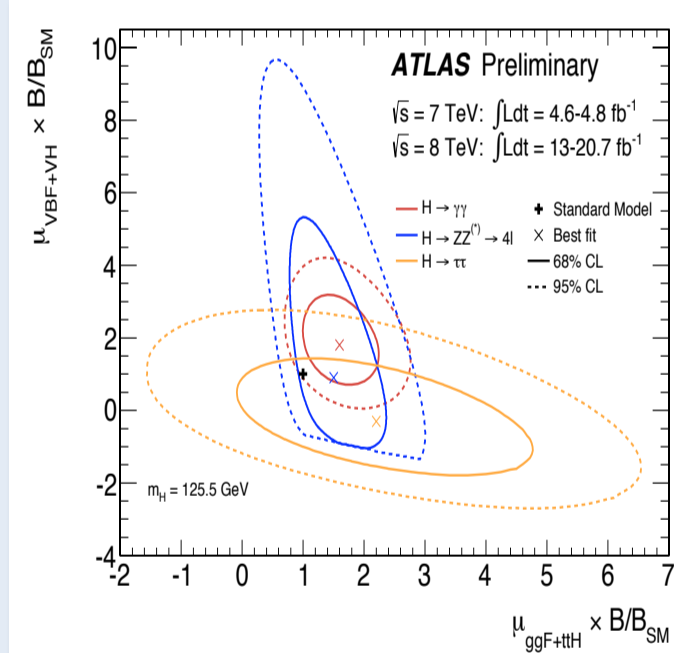
- $H \rightarrow \gamma\gamma$ : low mass range, high mass resolution;
- $H \rightarrow ZZ^{(*)}$ : full mass range. Four leptons channel: high purity and mass resolution;
- $H \rightarrow WW^{(*)}$ : full mass range, small mass resolution, high rate;
- $H \rightarrow \tau\tau$ : low mass range;
- $VH \rightarrow V + bb$ : low mass range, associated production  $VH$ ,  $V = Z$  or  $W$ .

### Signal strength:

Signal strength parameter for the individual channels (@125.5 GeV) and for their combination [1]:



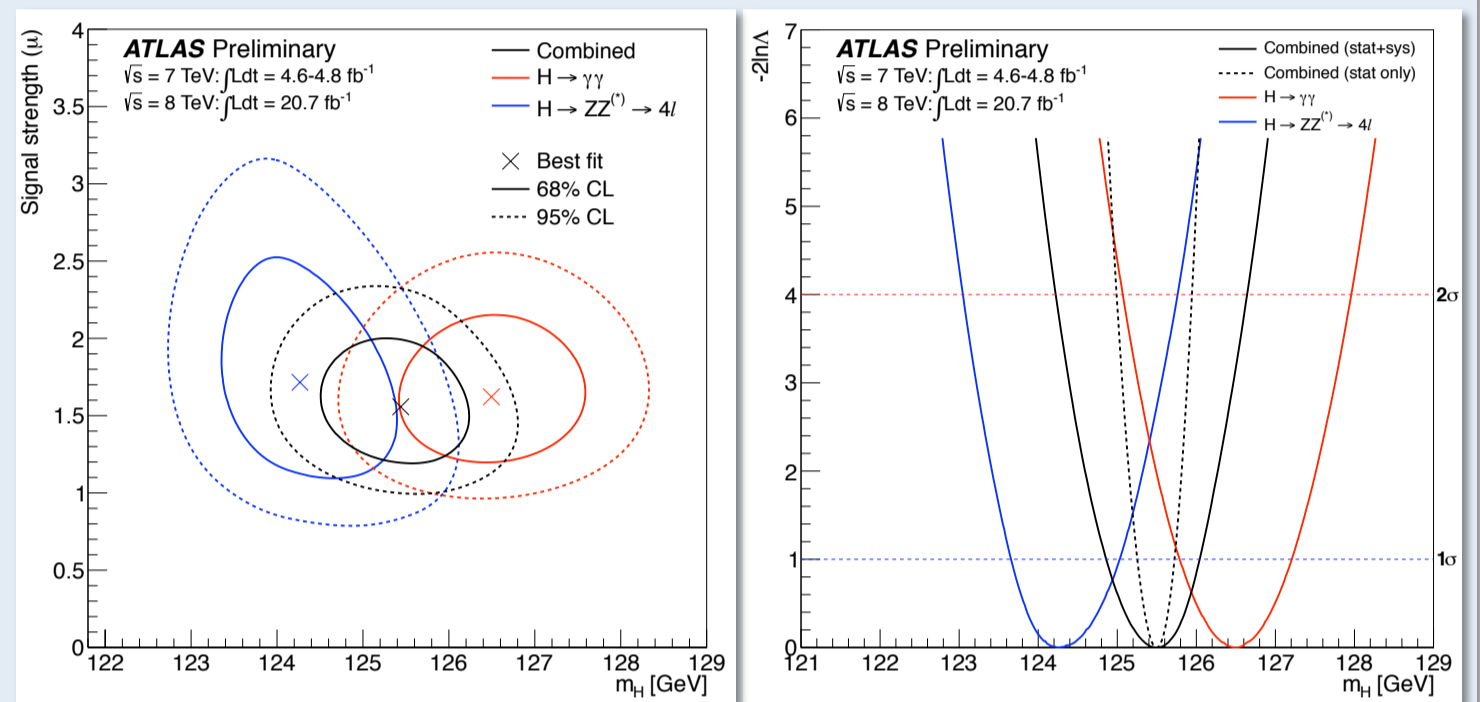
Likelihood contours in the plane  $\mu_{ggF+ttH} \mu_{VBF+VH}$  for the  $\gamma\gamma$ ,  $4l$  and  $\tau\tau$  channels [1]:



### Higgs mass:

$H \rightarrow \gamma\gamma$  and  $H \rightarrow ZZ^{(*)} \rightarrow 4l$  best-fit values of  $m_H - \mu$  (with the corresponding 1-2  $\sigma$  contours) and  $-2 \ln \Lambda(m_H)$  as a function of  $m_H$  [1]:

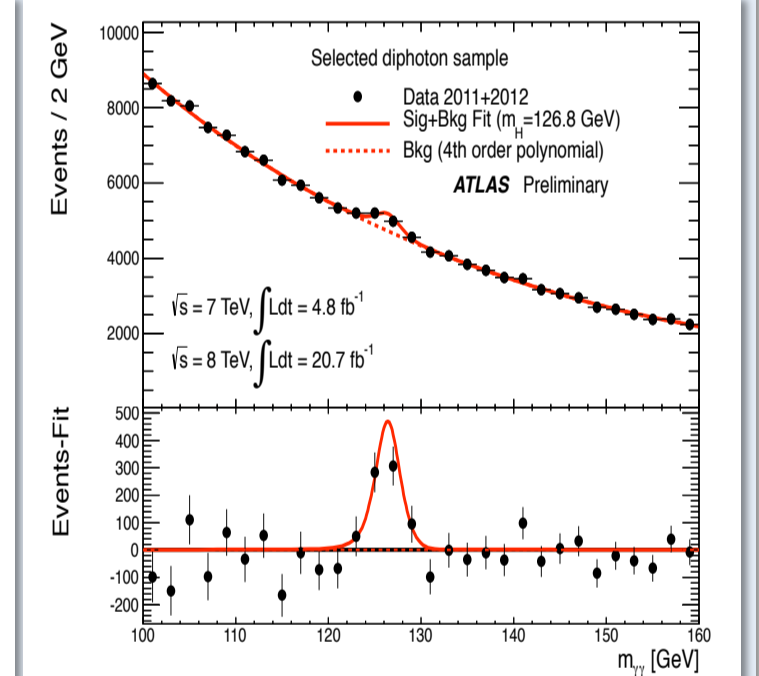
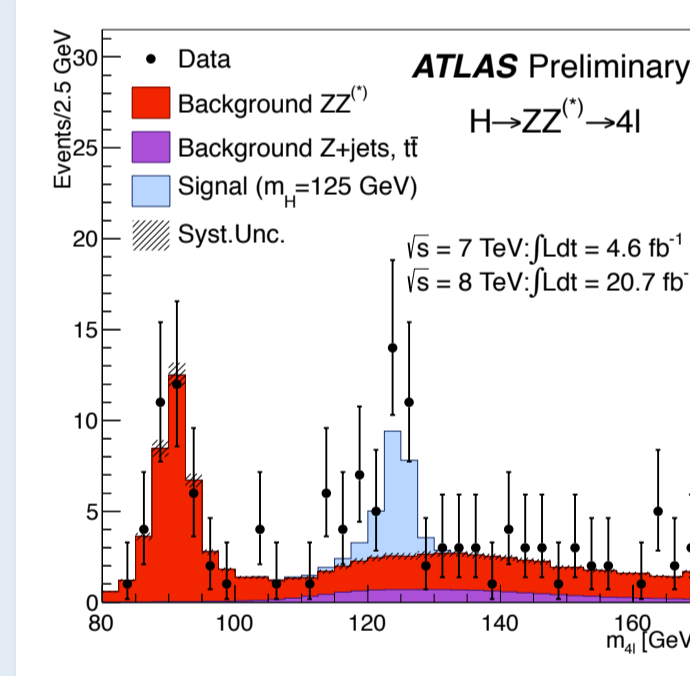
Combined mass:  $125.5 \pm 0.2(\text{stat})_{-0.6}^{+0.5}(\text{sys}) \text{ GeV}$



Invariant mass spectrum for the channels  $H \rightarrow ZZ^{(*)} \rightarrow 4l$  [2] and  $H \rightarrow \gamma\gamma$  [3]:

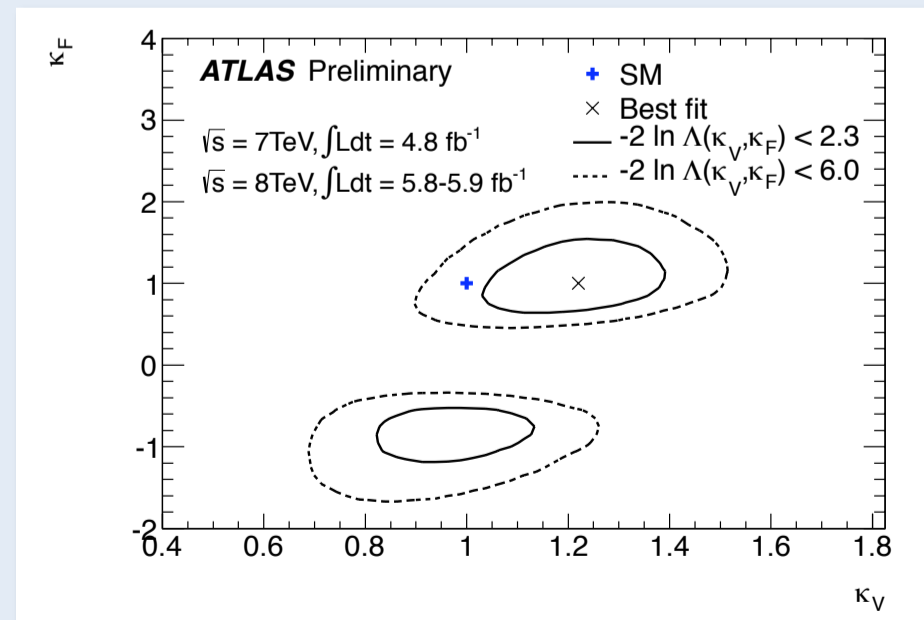
Significance<sub>4l</sub> = 6.6  $\sigma$  (exp. 4.4  $\sigma$ )

Significance<sub>gamma gamma</sub> = 7.4  $\sigma$  (exp. 4.1  $\sigma$ )

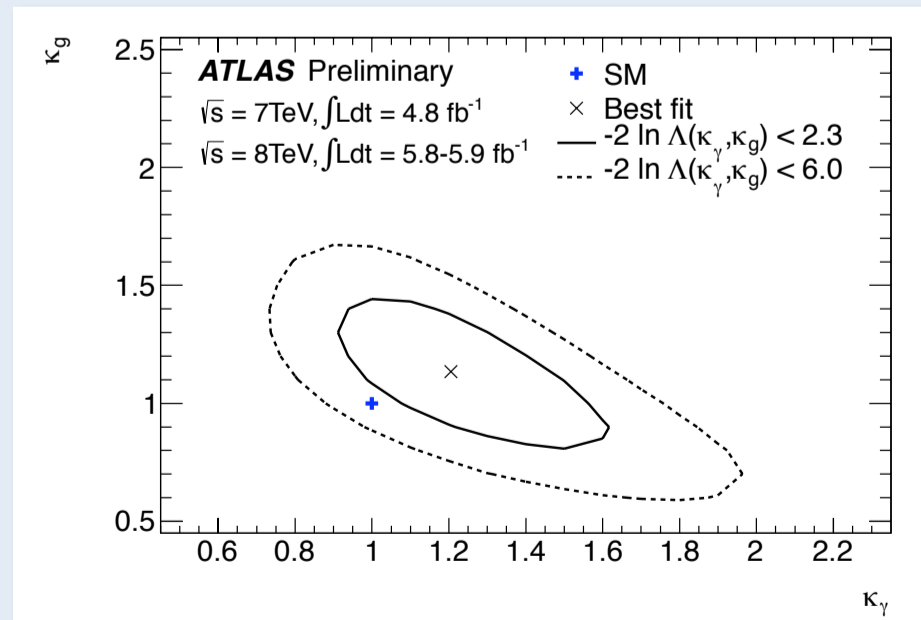


### Higgs couplings:

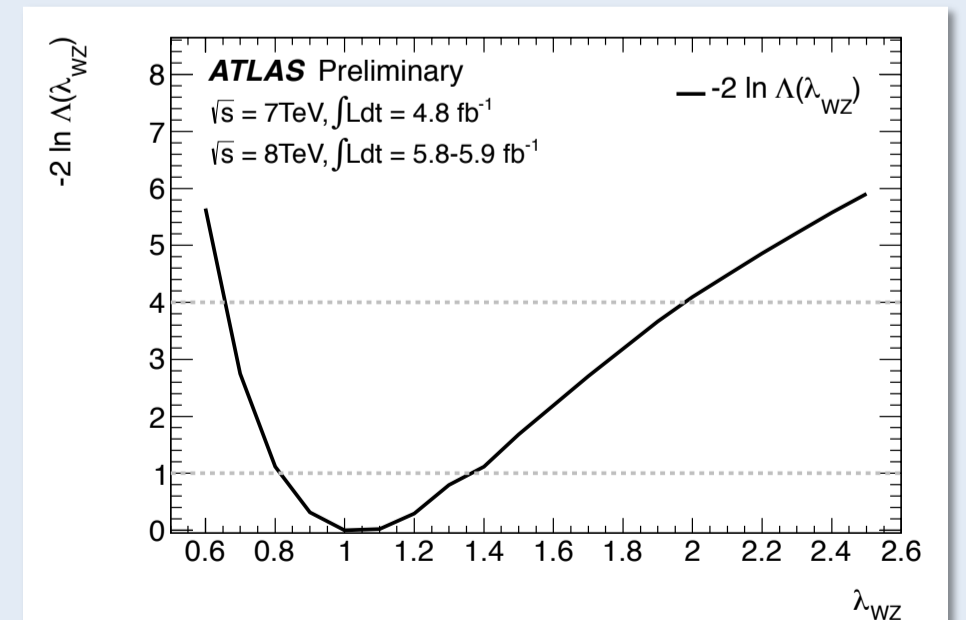
Probing different coupling strength scale factors for fermions\* and vector bosons [4]:



Probing loop structure\*  $gg \rightarrow H$  and  $H \rightarrow \gamma\gamma$  (contribution from non-SM particles) [4]:



Probing the ratio  $\lambda_{WZ} = \kappa_W/\kappa_Z$  [4]:



\*assuming no non-SM contribution to the total width.

### Conclusions:

- The observation of the Higgs-like particle is fully confirmed on all the most sensitive channels [5];
- First measurements of couplings are consistent with SM expectation.

### References:

- [1] ATLAS-CONF-2013-014;
- [2] ATLAS-CONF-2013-013;
- [3] ATLAS-CONF-2013-012;
- [4] ATLAS-CONF-2012-127;
- [5] Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC: Phys. Lett. B 716 (2012) 1-29.