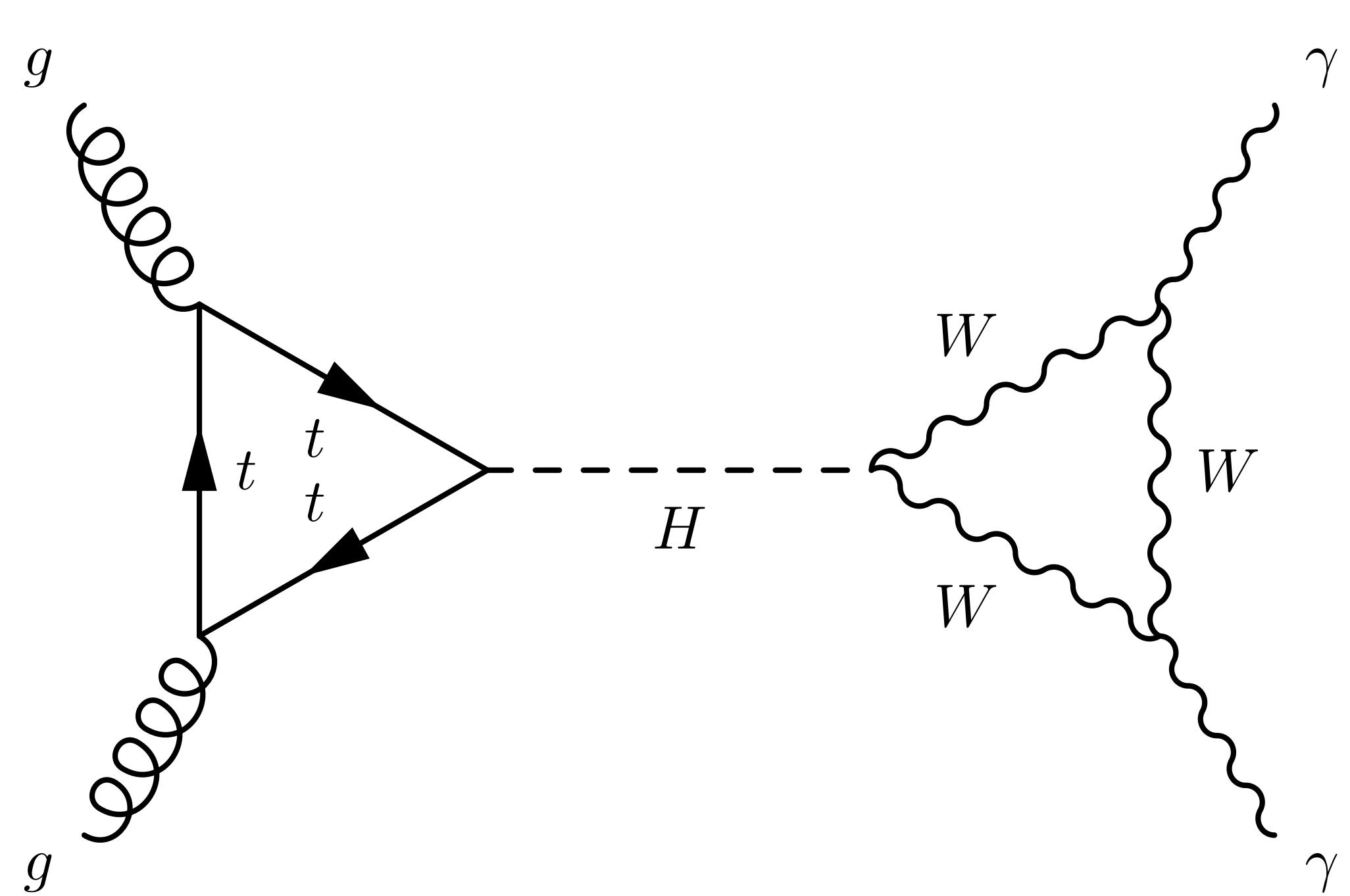


# Experimental particle. physics

**esipap...**  
European School of Instrumentation  
in Particle & Astroparticle Physics

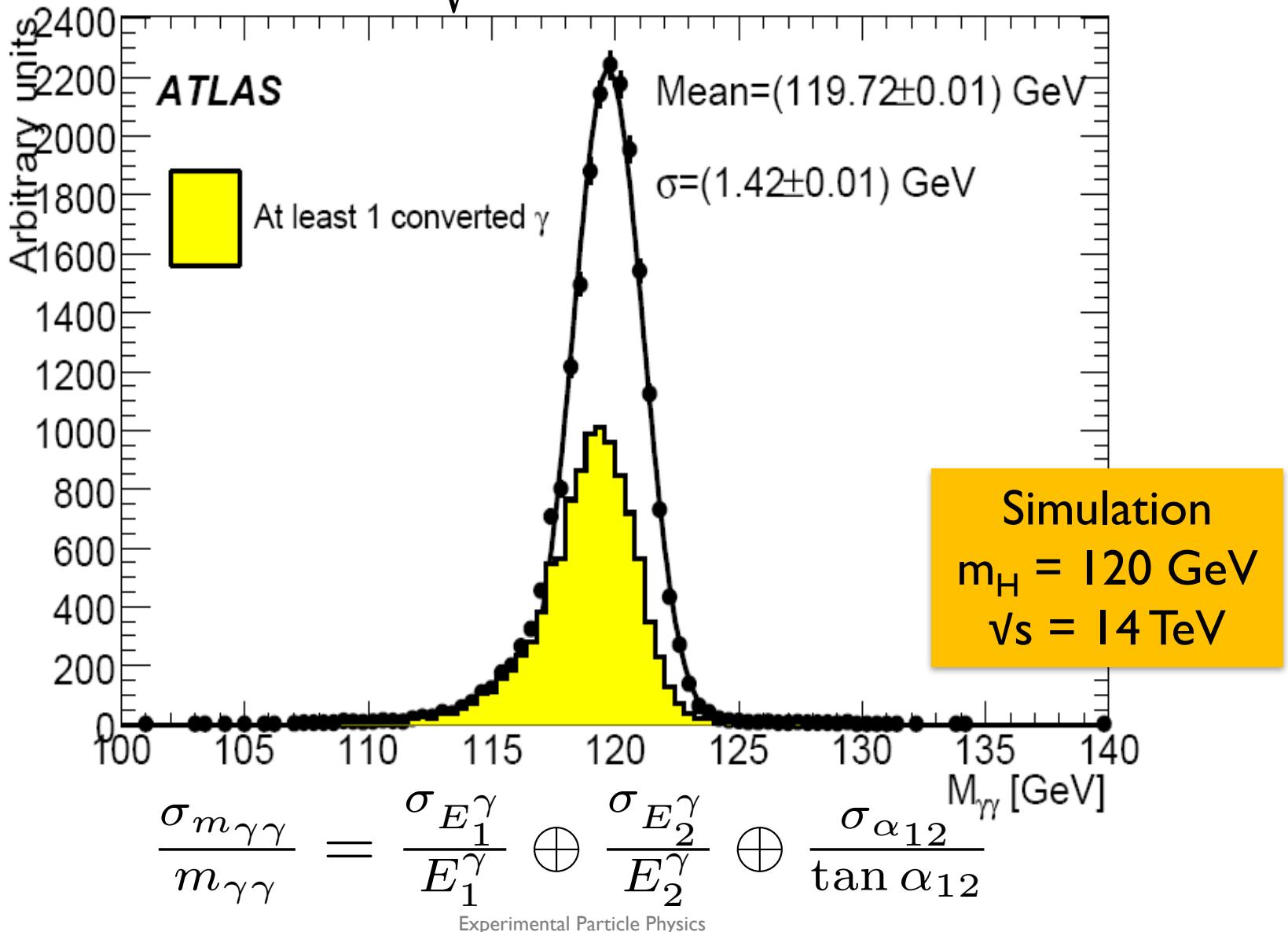


Significance of  
 $H \rightarrow \gamma\gamma$  signal

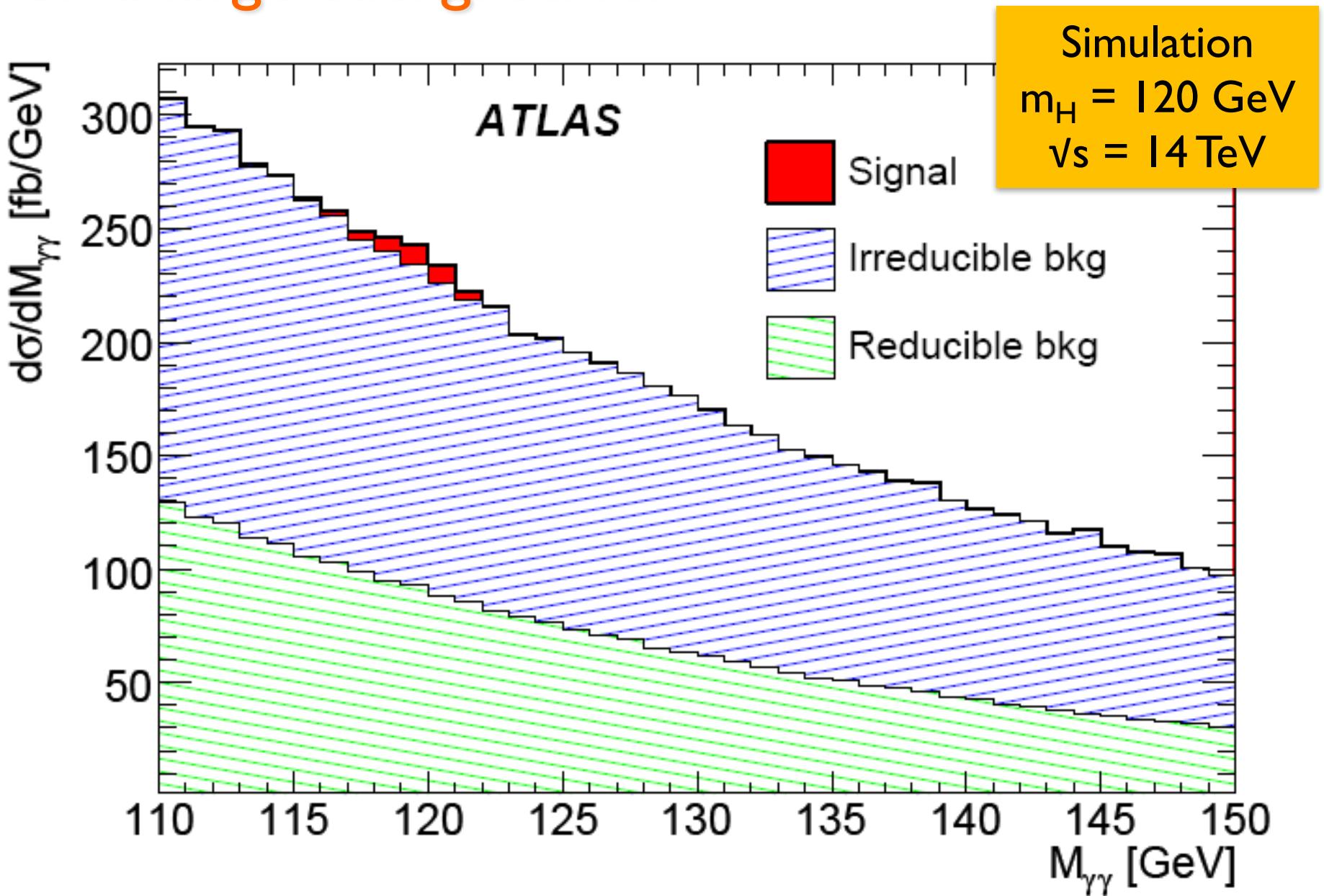


# A narrow mass peak...

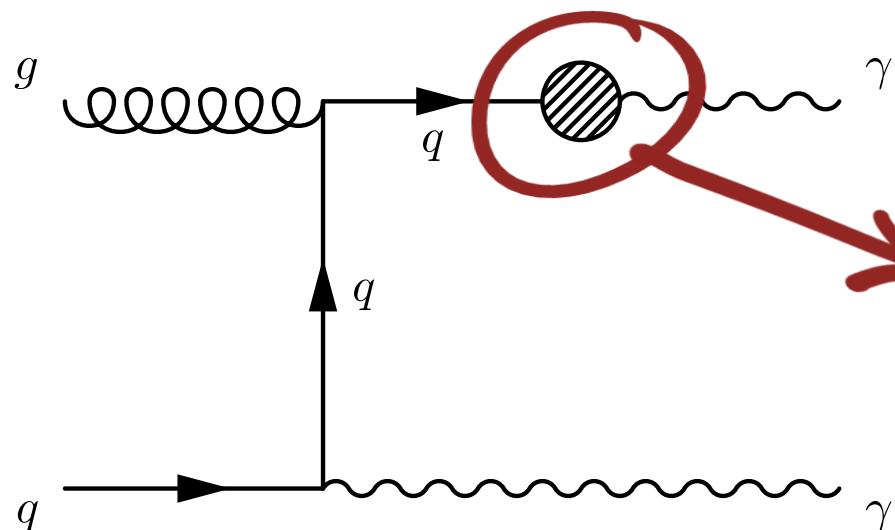
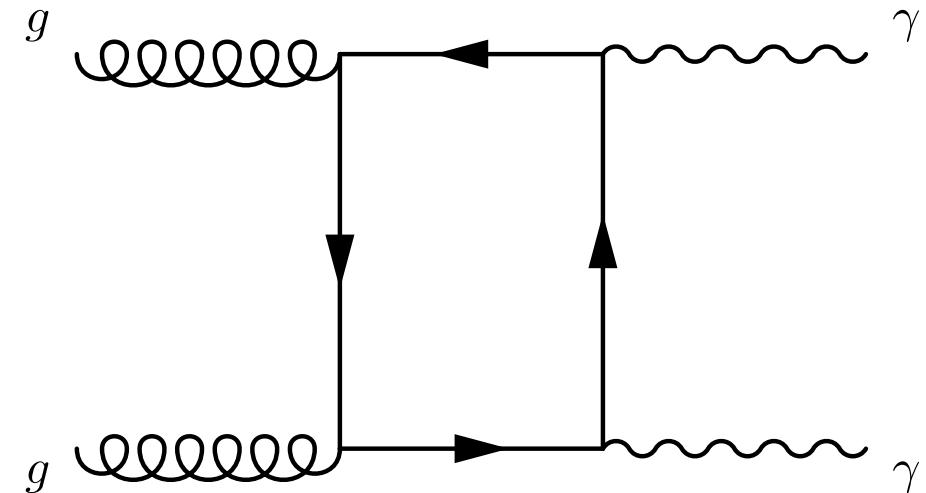
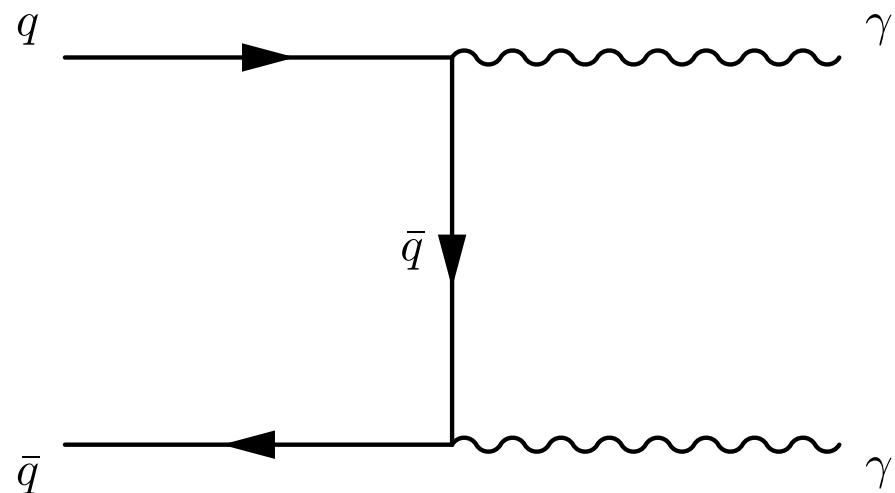
$$m_{\gamma\gamma} = \sqrt{2E_1^\gamma E_2^\gamma (1 - \cos \alpha_{12})}$$



... on a large background!

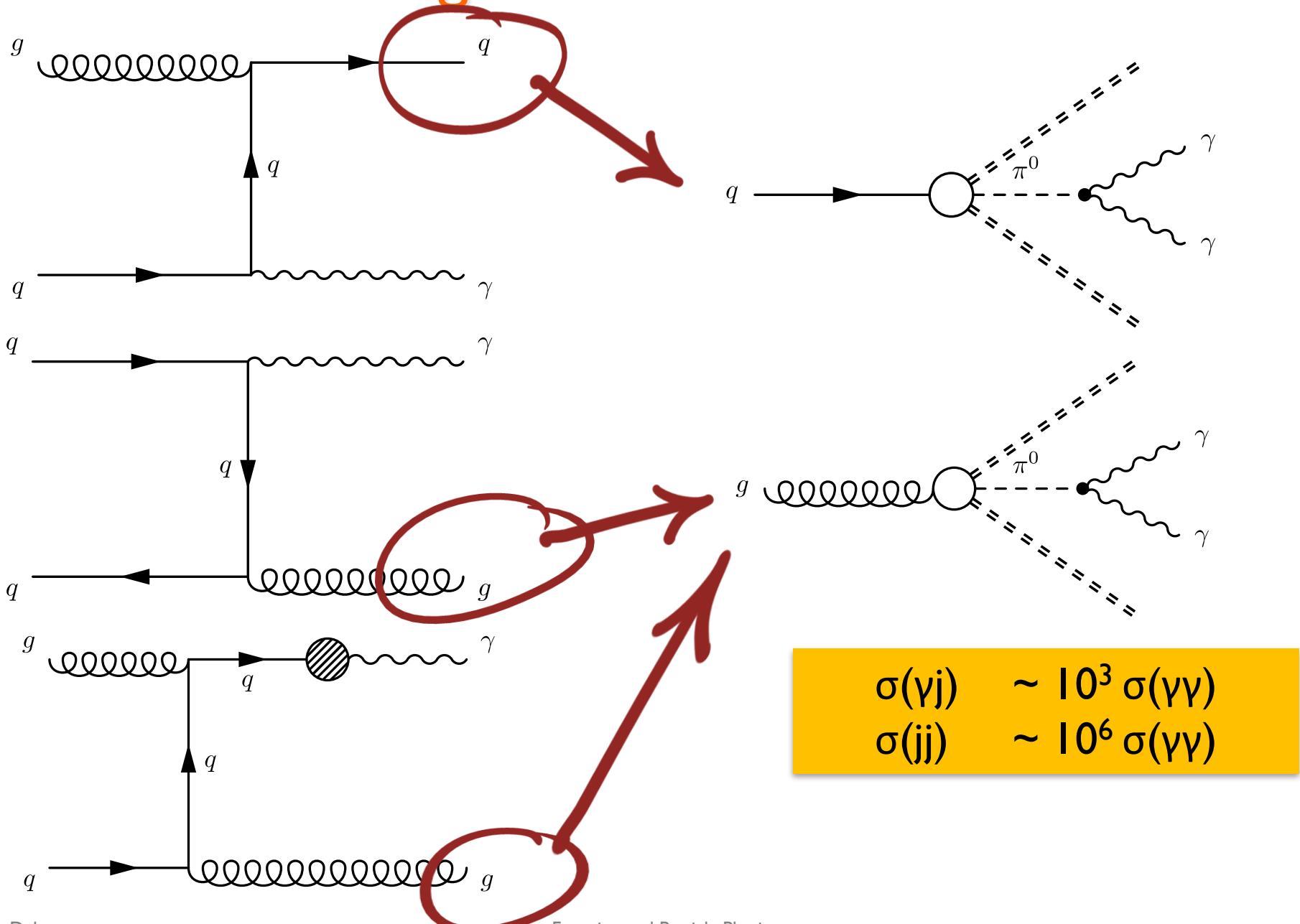


# “Irreducible” background



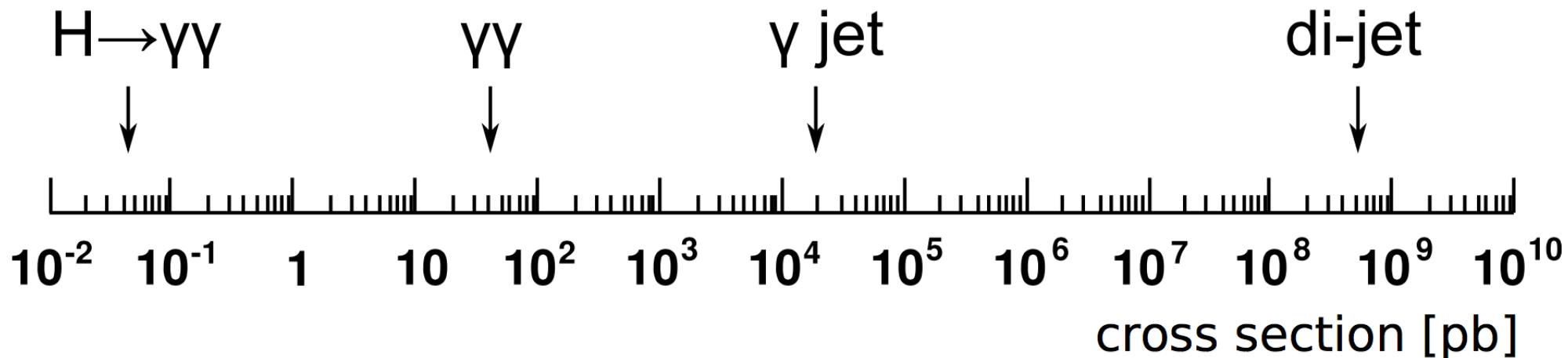
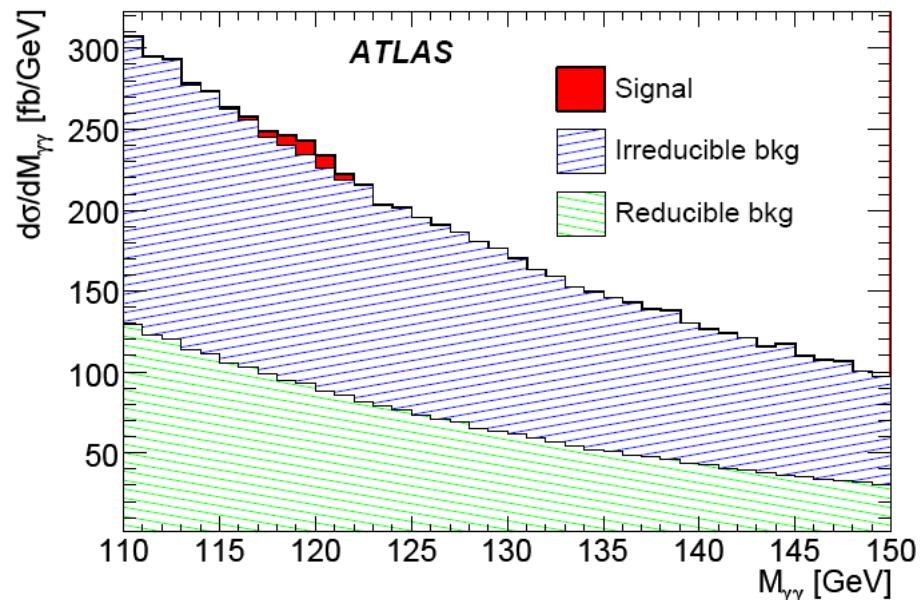
parton fragmentation

# “Reducible” background



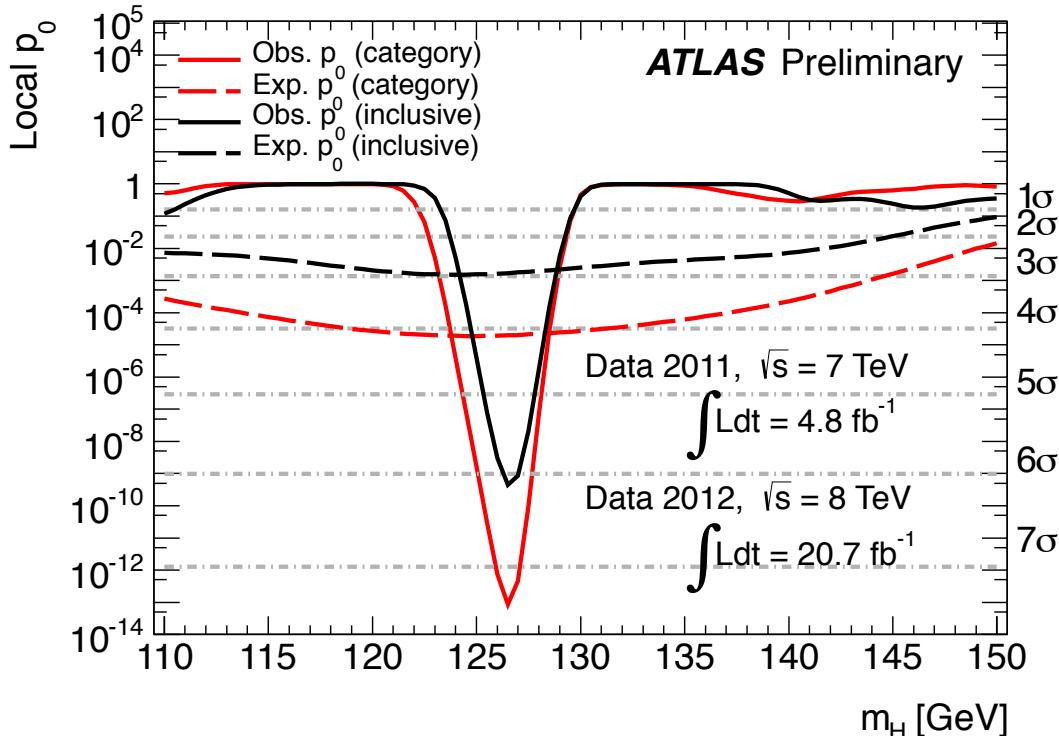
# Signal vs. background

- small branching ratio ( $\sim 10^{-3}$ )
- huge background
  - ✓  $\gamma\gamma$ ,  $\gamma j$ ,  $jj$ , Drell-Yan
- S/B  $\sim 3\%$



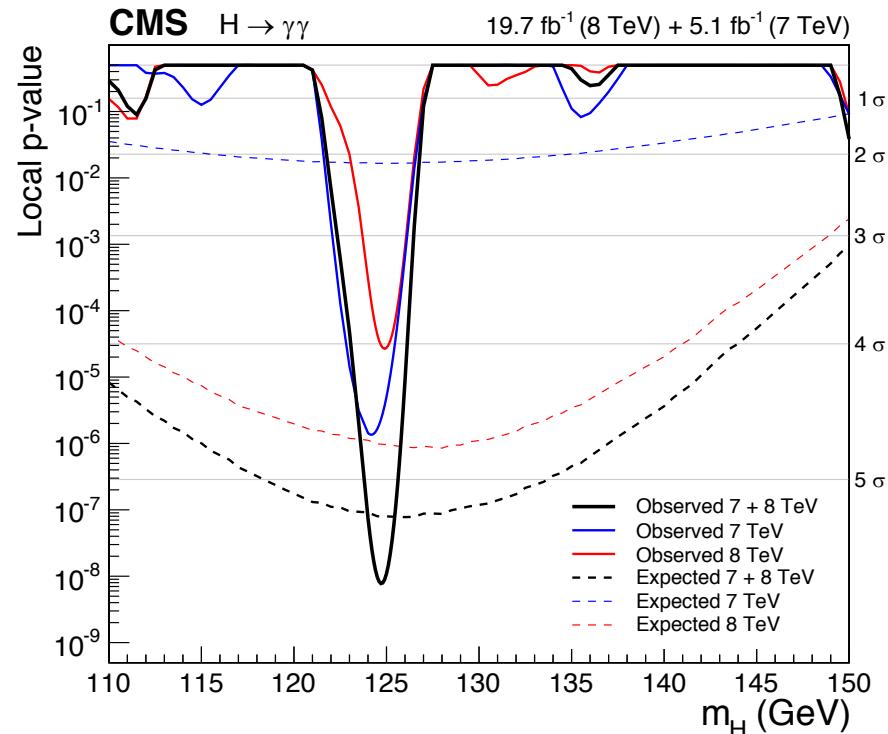
# $H \rightarrow \gamma\gamma$ significance

ATLAS



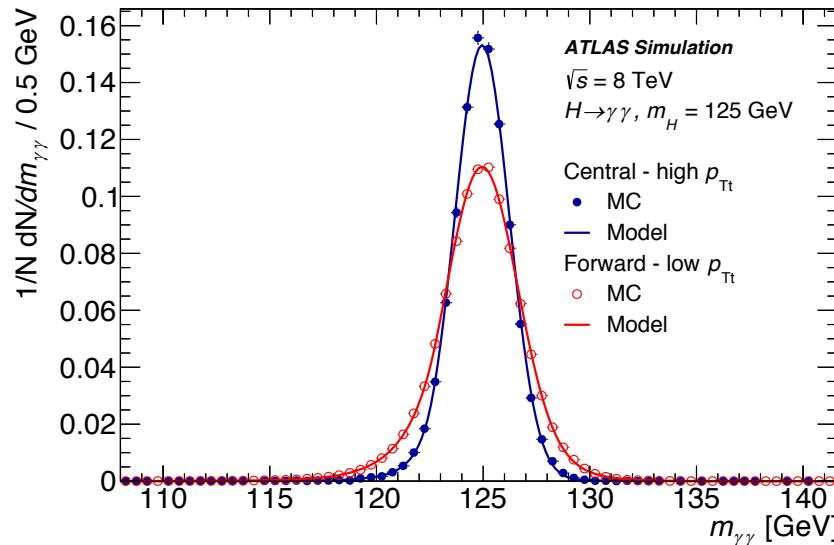
[ATLAS-CONF-2013-012](#)

CMS



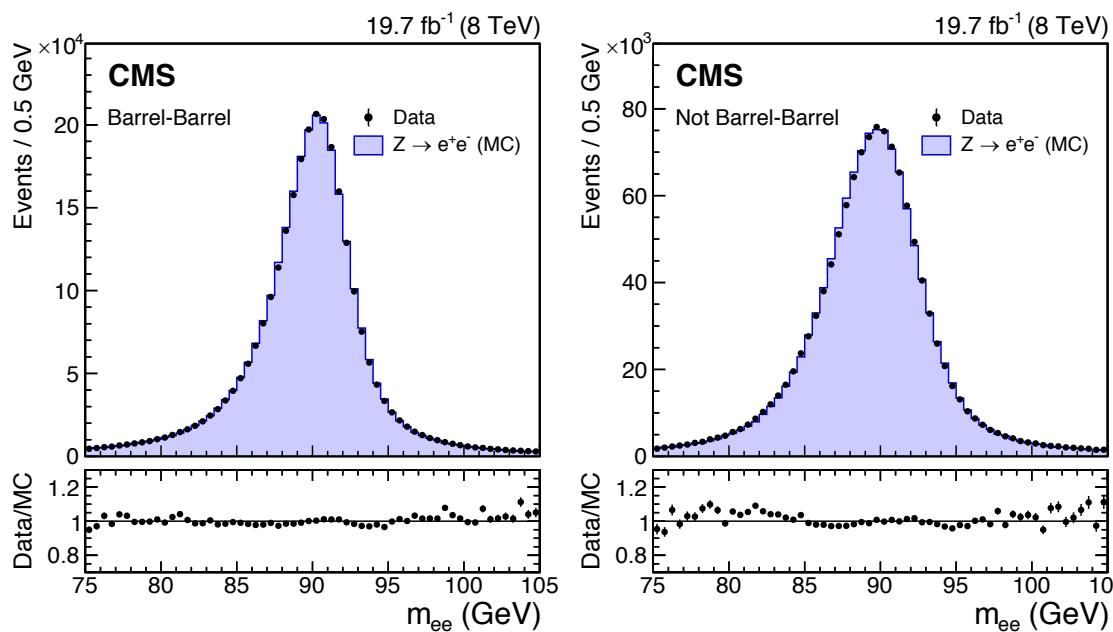
[Eur. Phys. J. C 74 \(2014\) 3076](#)

# $H \rightarrow \gamma\gamma$ invariant mass resolution



ATLAS

[Phys. Rev. D. 90, 112015 \(2014\)](#)

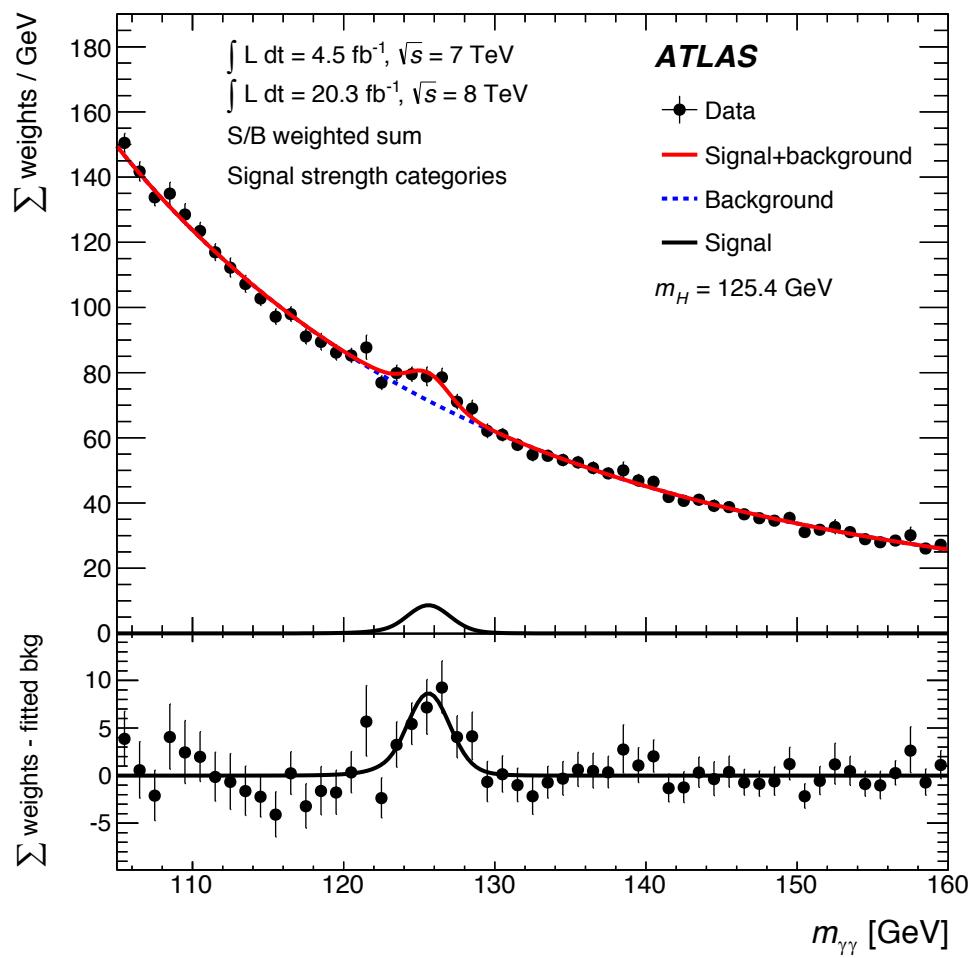


CMS

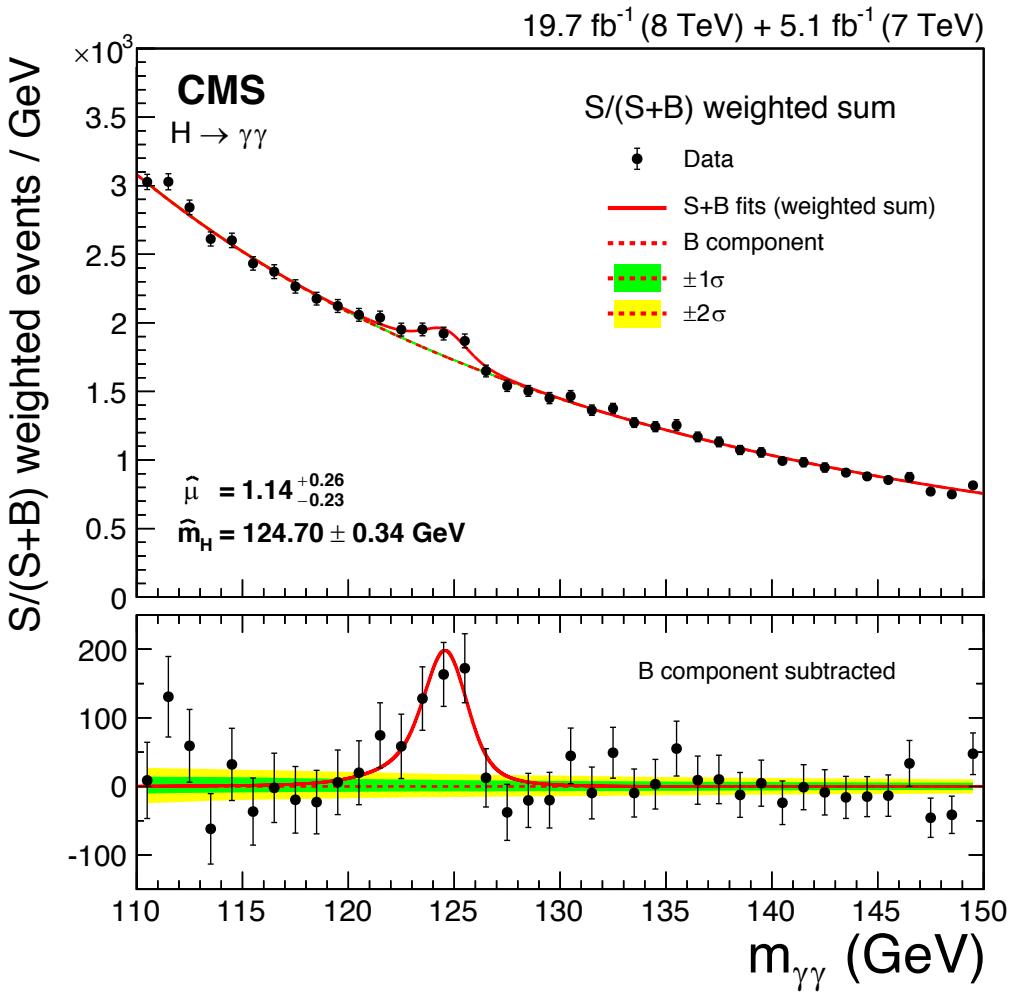
[Eur. Phys. J. C 74 \(2014\) 3076](#)

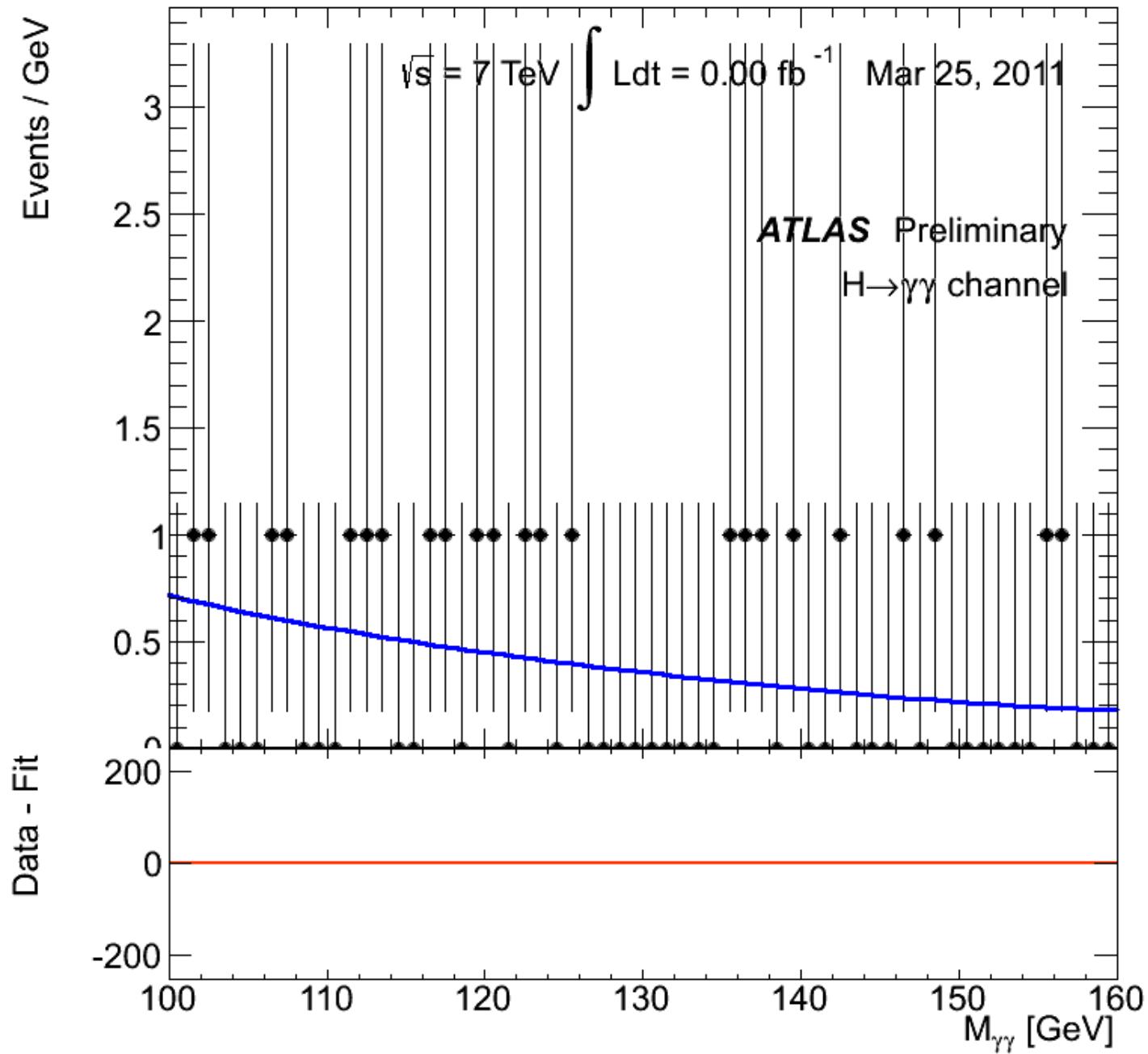
# $H \rightarrow \gamma\gamma$ (weighted) mass spectra

ATLAS



CMS





# $H \rightarrow \gamma\gamma$ signal and background “toy”models

- $\gamma\gamma$  background approximated model

$$\frac{d\sigma_{\text{background}}}{dm_{\gamma\gamma}} = 1145[\text{fb}/\text{GeV}]e^{-0.023[\text{GeV}^{-1}]m_{\gamma\gamma}}$$

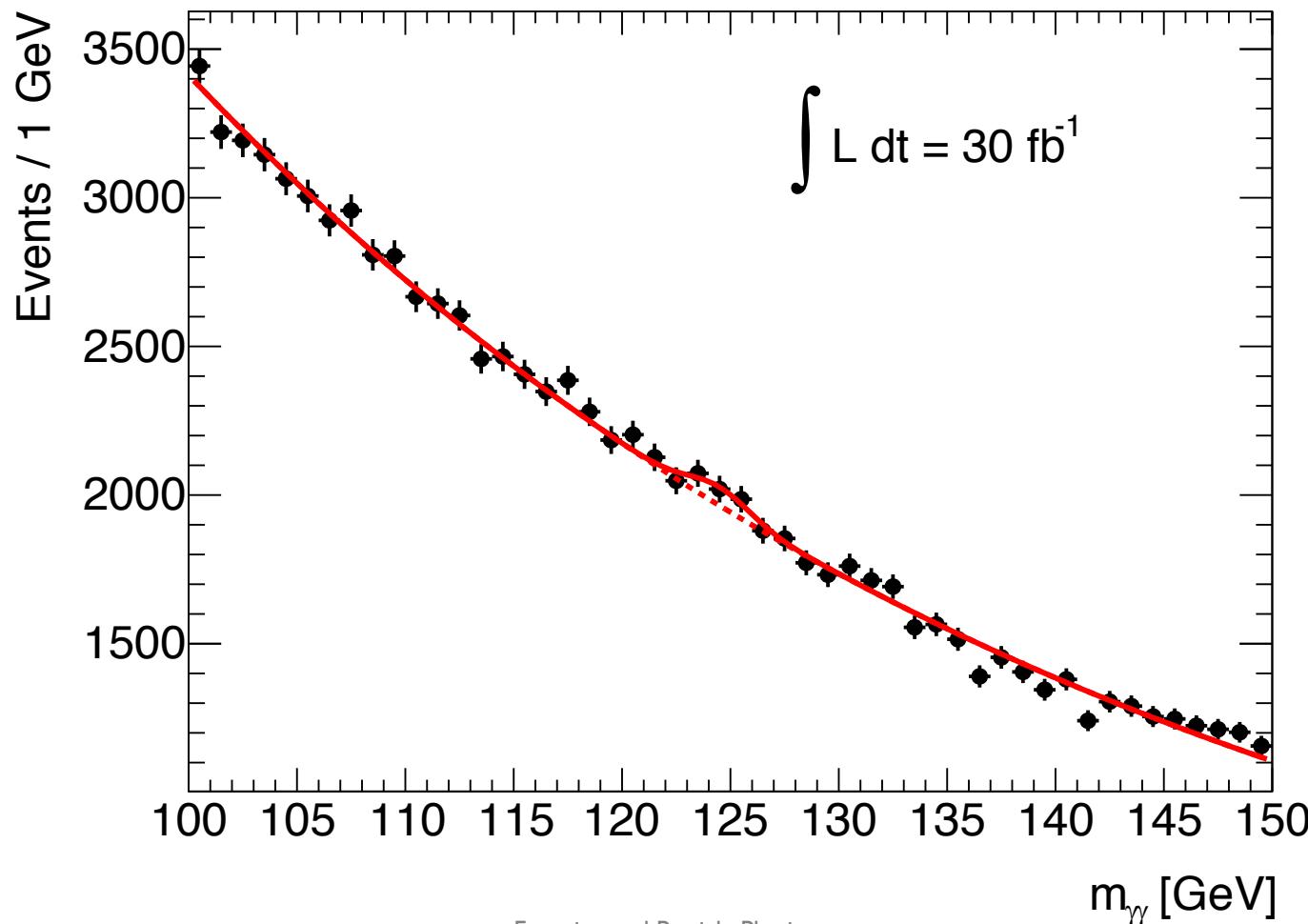
- $H \rightarrow \gamma\gamma$  approximated model

$$\sigma(m_H = 125\text{GeV}) \times BR \times \varepsilon_{\text{experiment}} \simeq 10\text{fb}$$

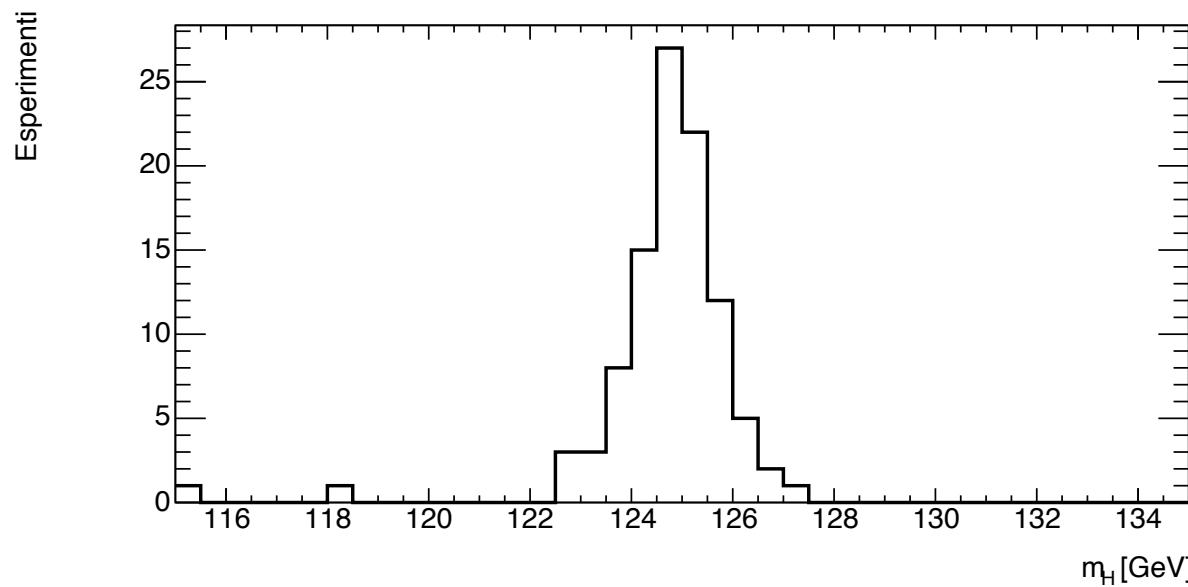
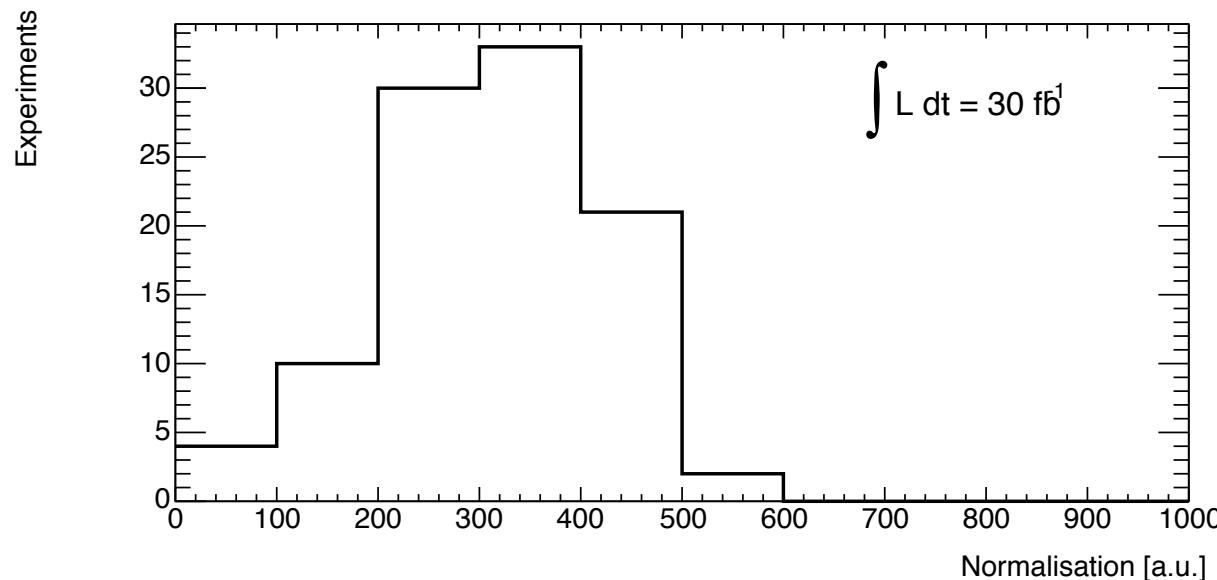
- Width dominated by invariant mass resolution  $\sigma_{\gamma\gamma}$

# $H \rightarrow \gamma\gamma$ fit “toy” example

$$p_0 e^{-p_1 m} + p_2 \frac{1}{\sqrt{2\pi p_4}} e^{-\frac{1}{2} \frac{(m-p_3)^2}{p_4^2}}$$



# Toy experiments (fluctuation can change the results!)



# Significance evolution

