Wγγ Analysis at the ATLAS Experiment

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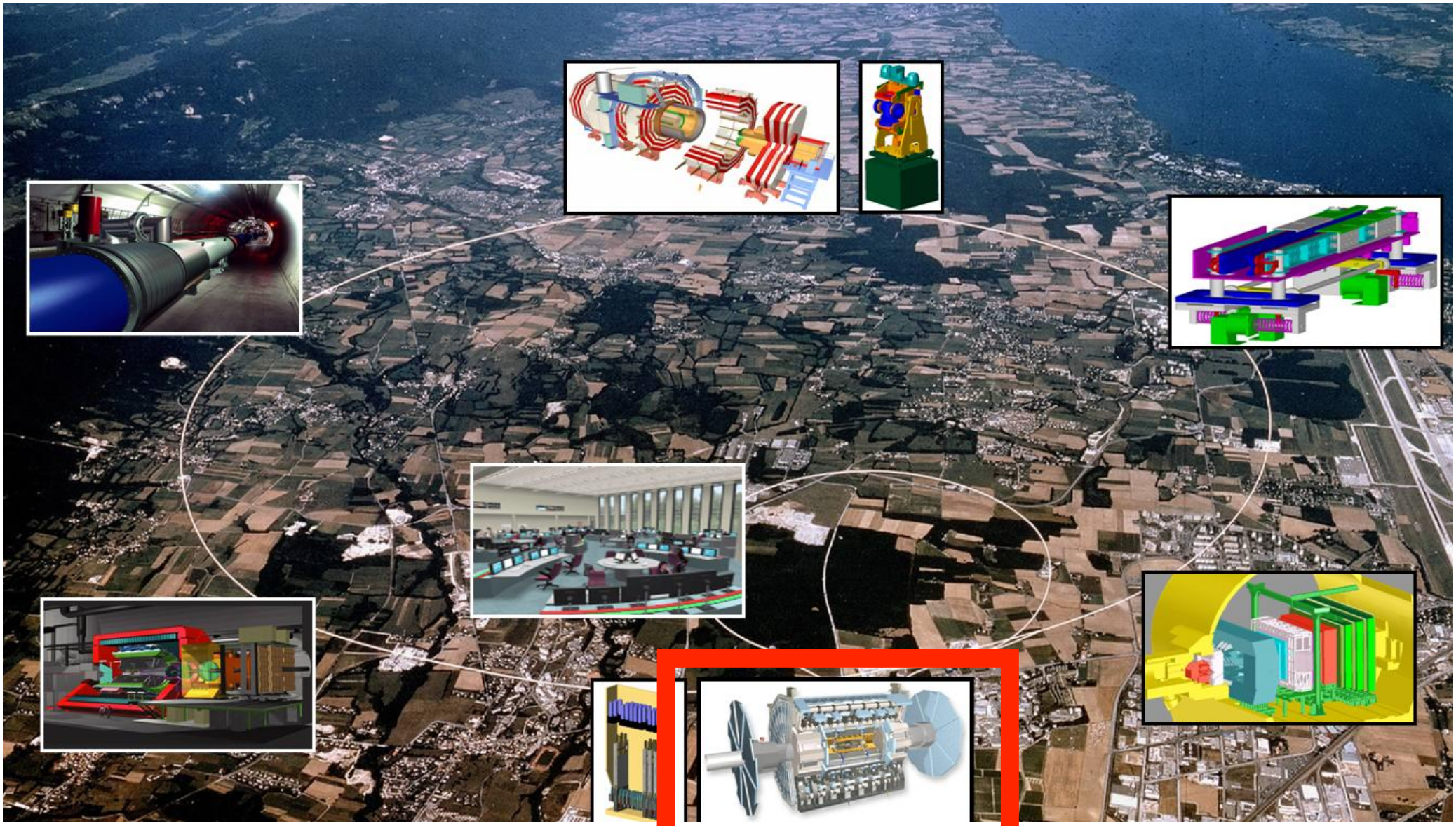
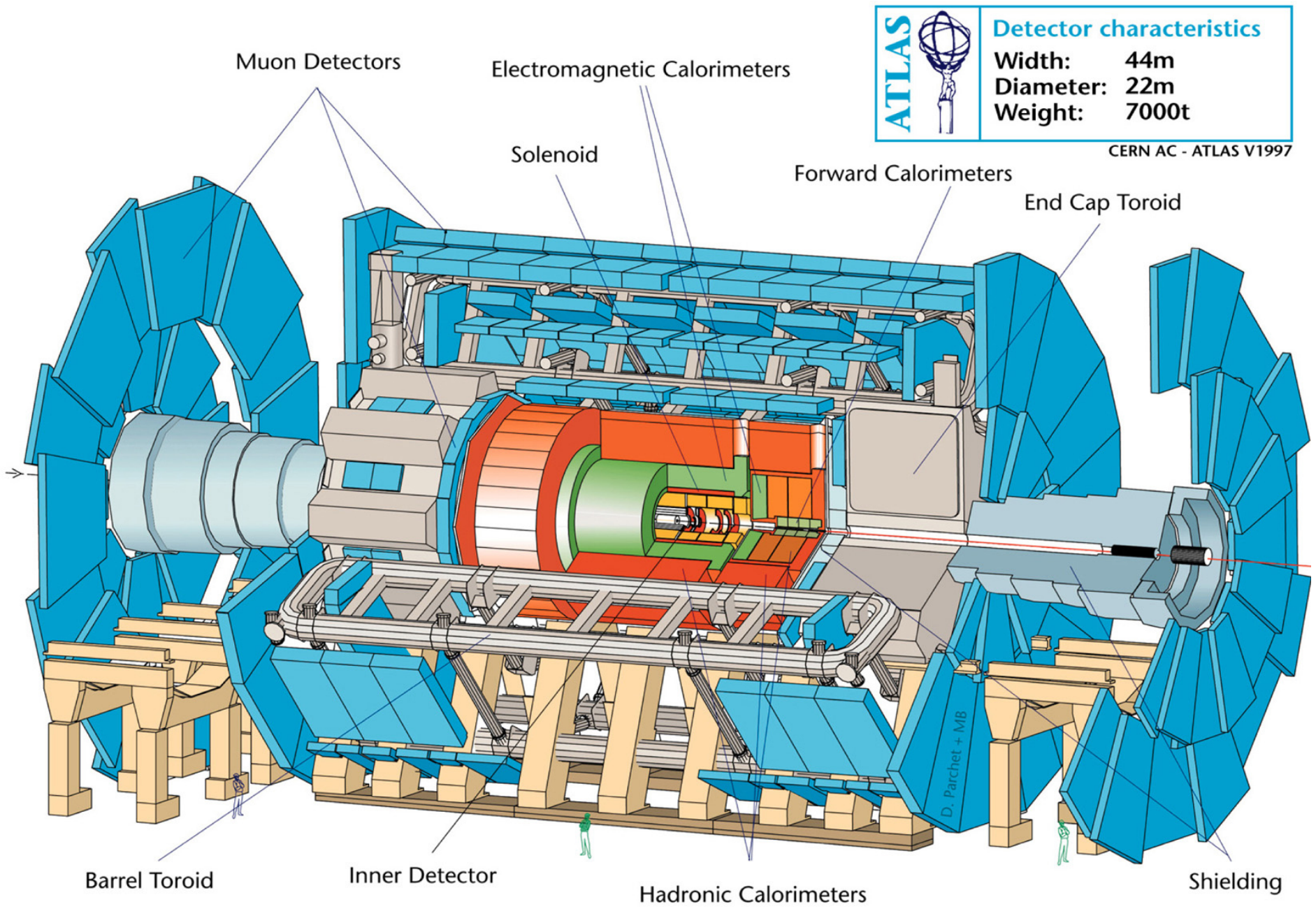
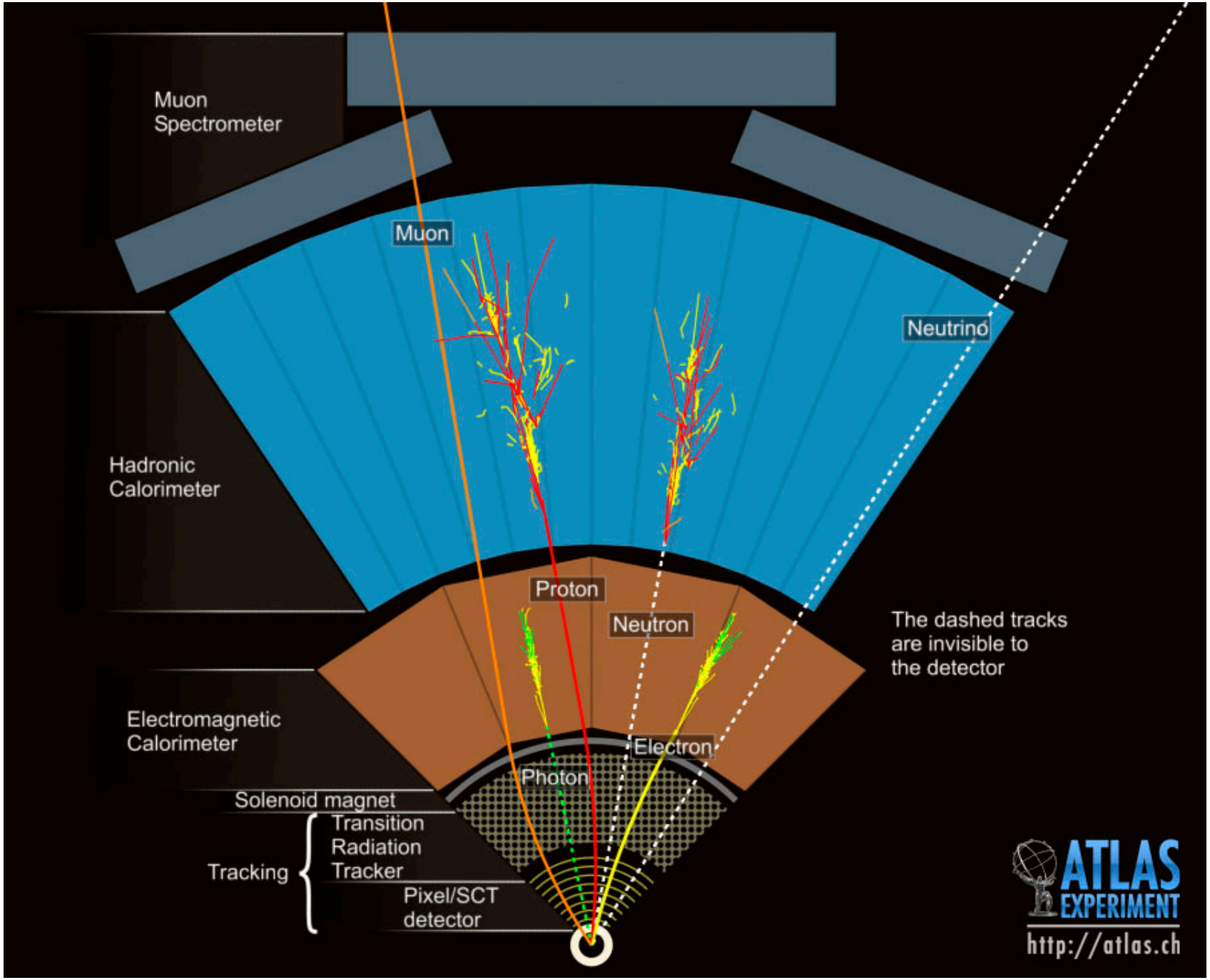
The ATLAS Experiment



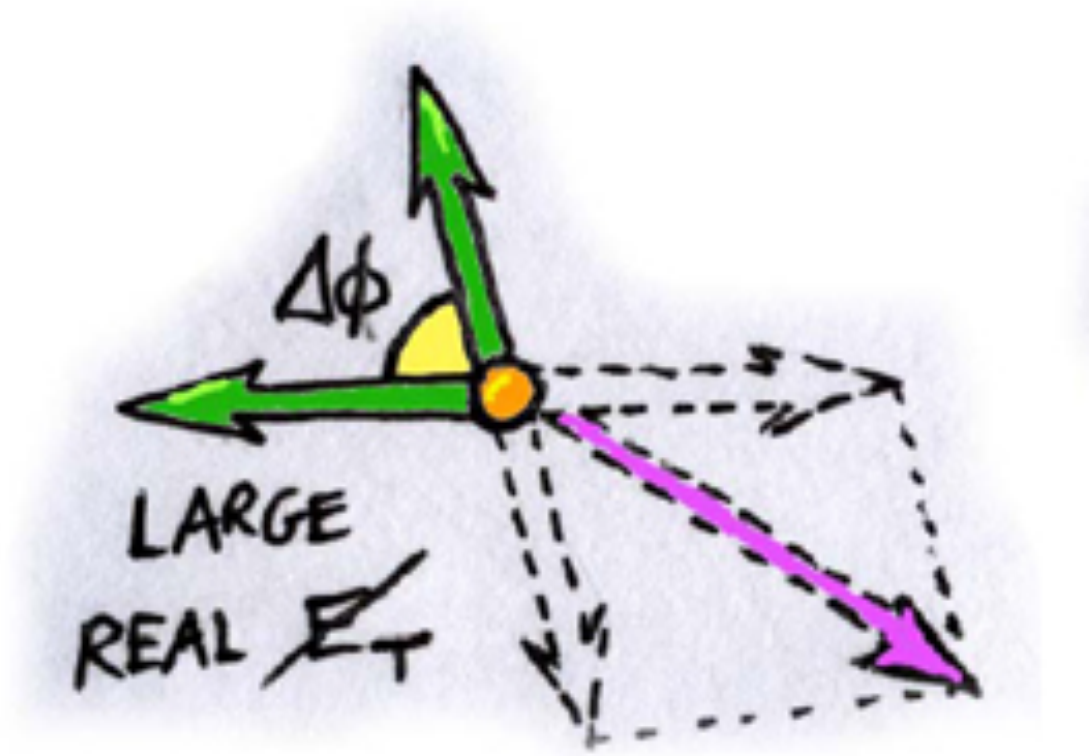
The ATLAS Experiment



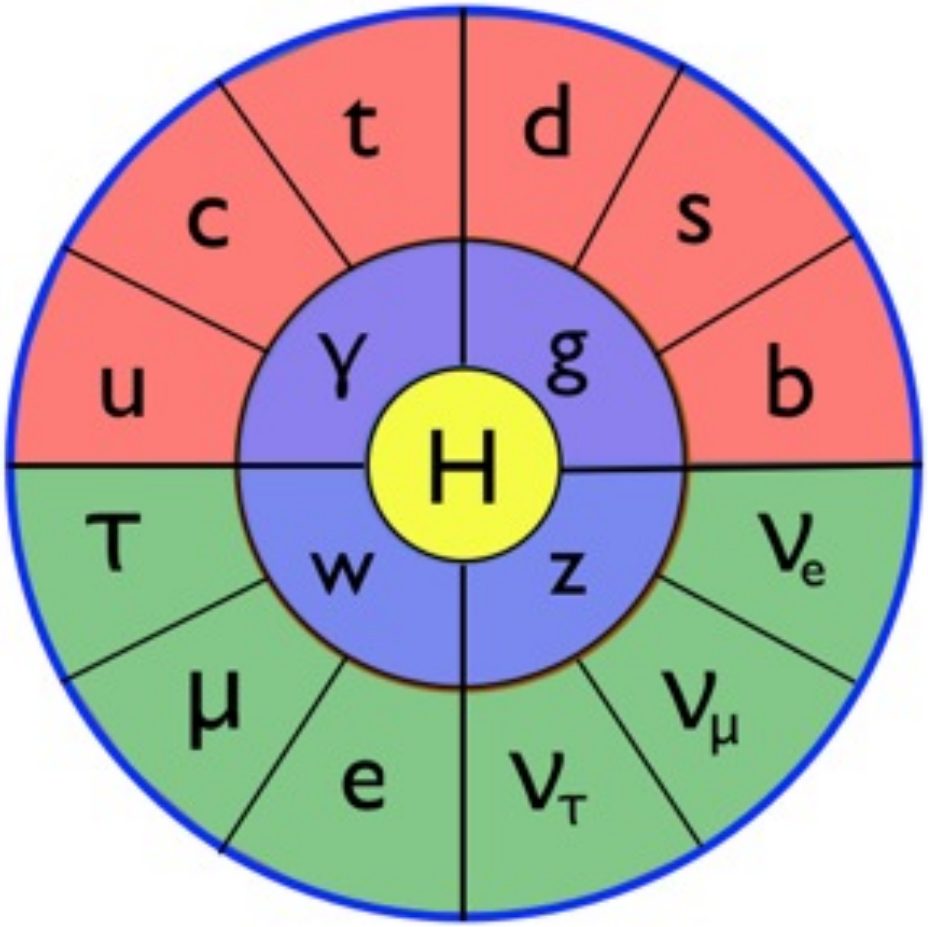
Particle Detection



Particle Detection



Standard Model



Fermions
Matter

Quarks

Leptons

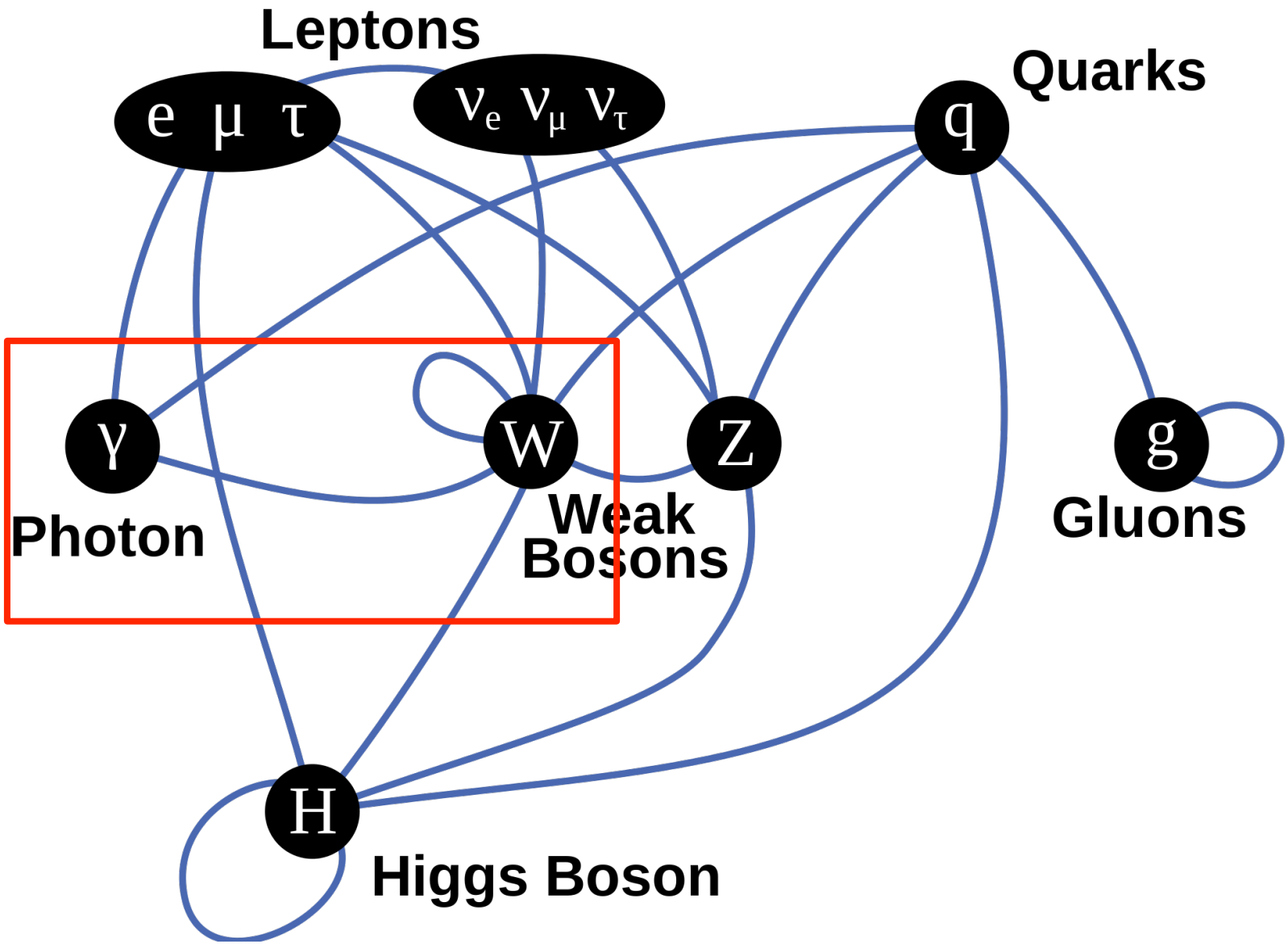
Bosons
Force Carriers

Gauge bosons

Higgs boson

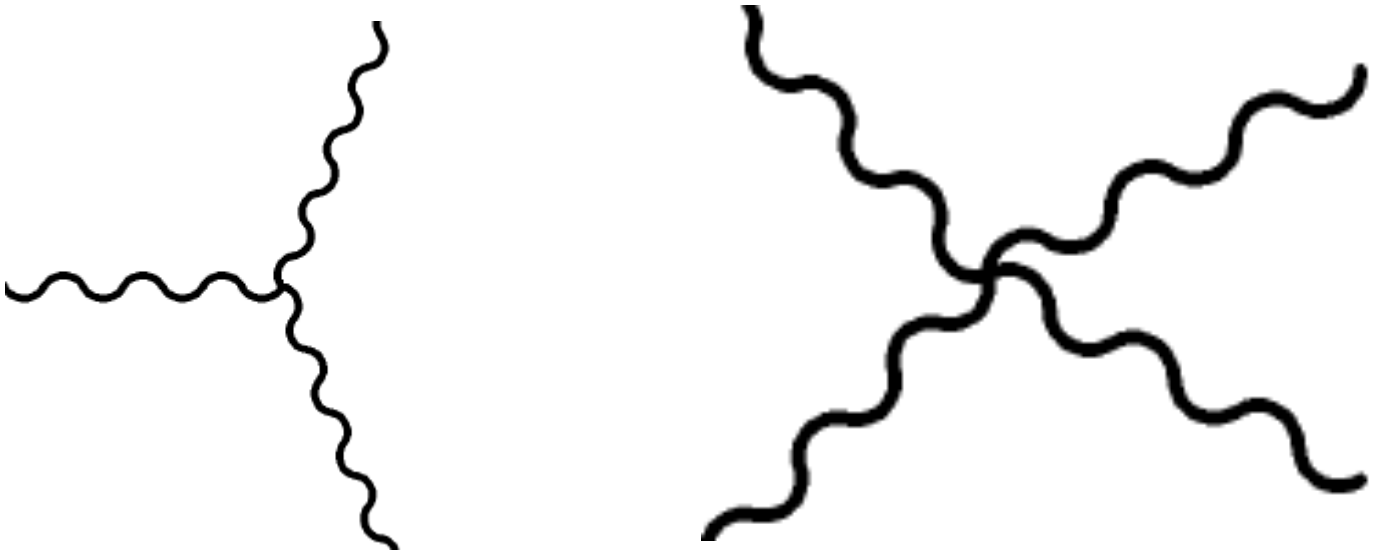
Particles of the Standard Model

EW Self Interactions



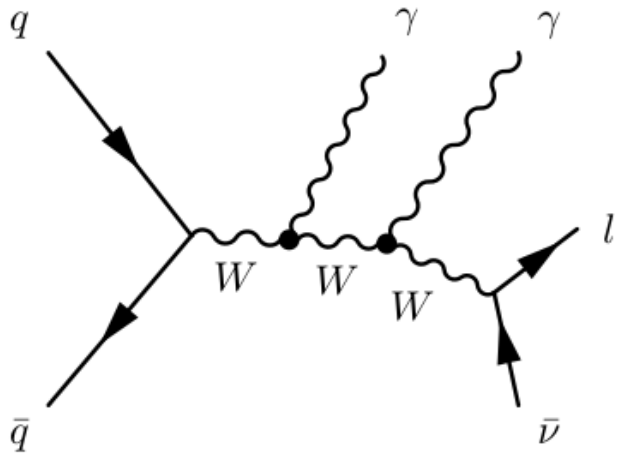
Electroweak Self Interaction

- $SU(2)_L$ x $U(1)_Y$: non-Abelian gauge group
- W, Z and γ (self-)interact

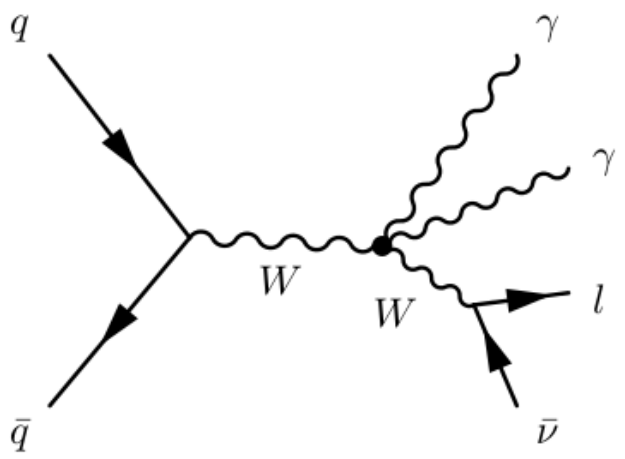


- completely determined by gauge-structure

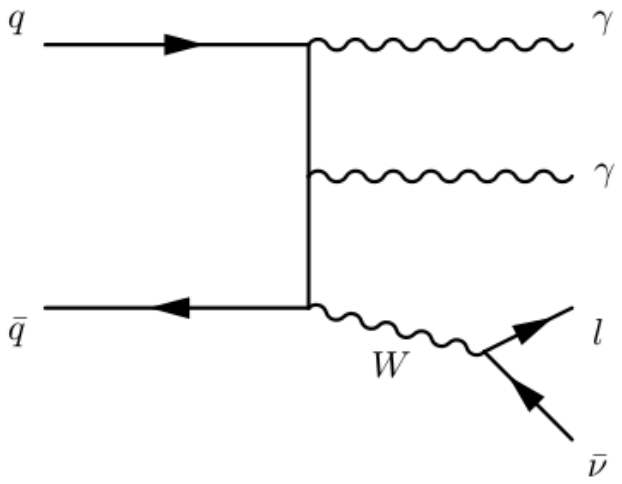
Wγγ production



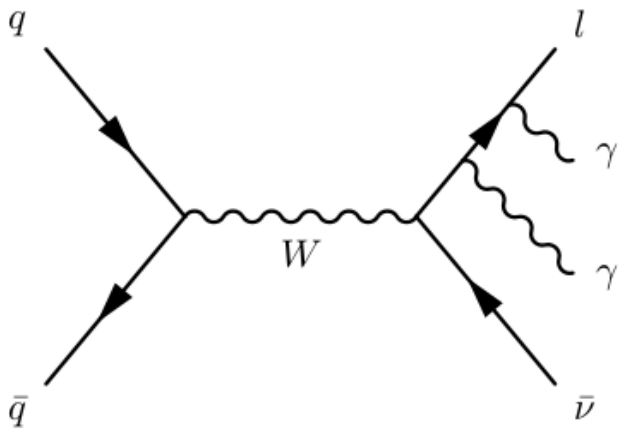
(a)



(b)

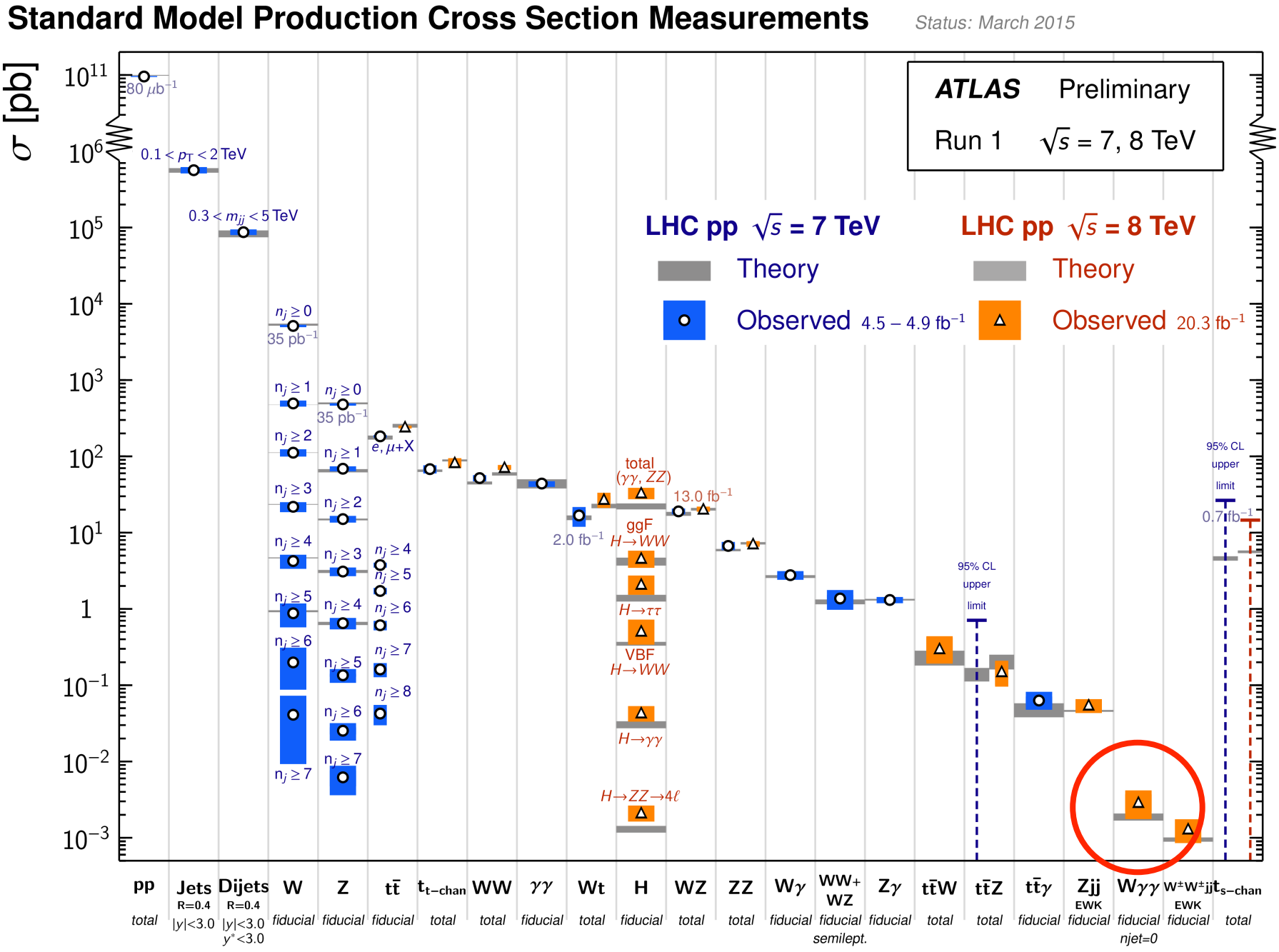


(c)



(d)

Wyy production

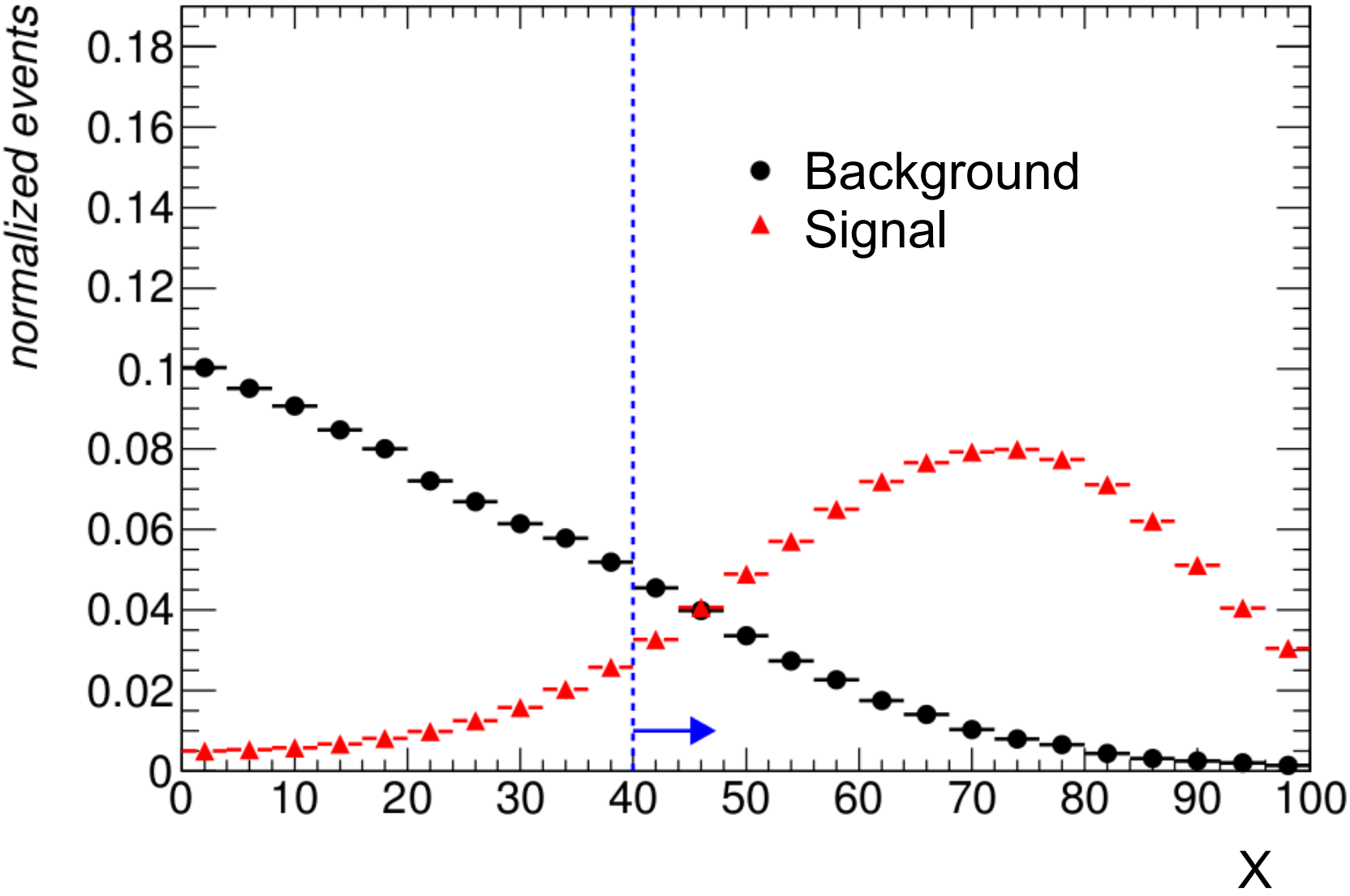


Cross-section measurement

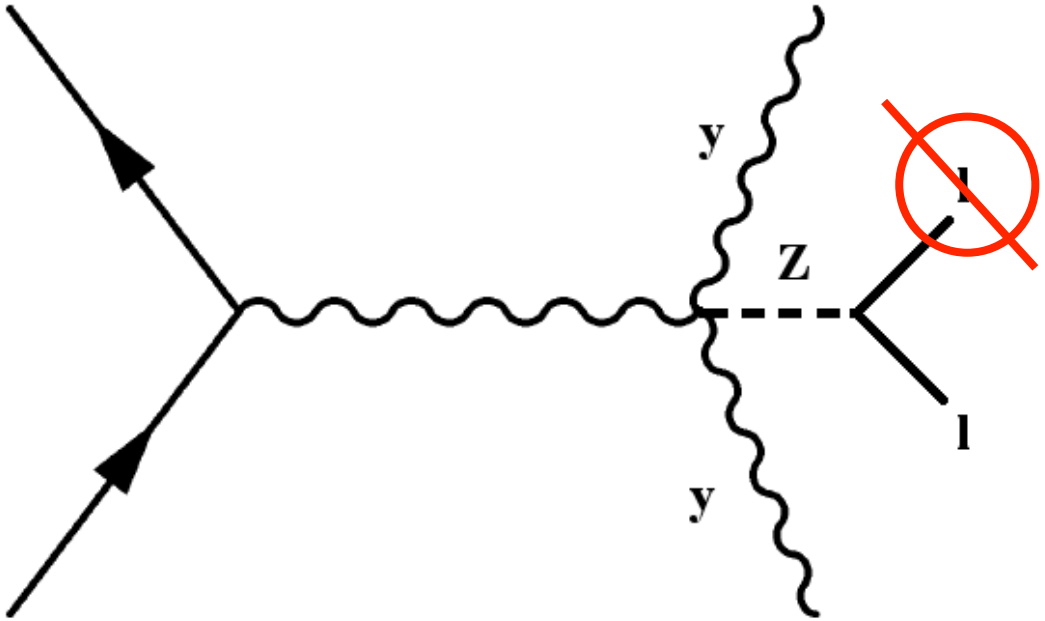
$$\sigma = \frac{N}{\int L\,dt}$$

$$\sigma = \frac{N_{obs} - N_{bkg}}{A \cdot \varepsilon \cdot \int L\,dt} \quad \boxed{= N_{W\gamma\gamma}}$$

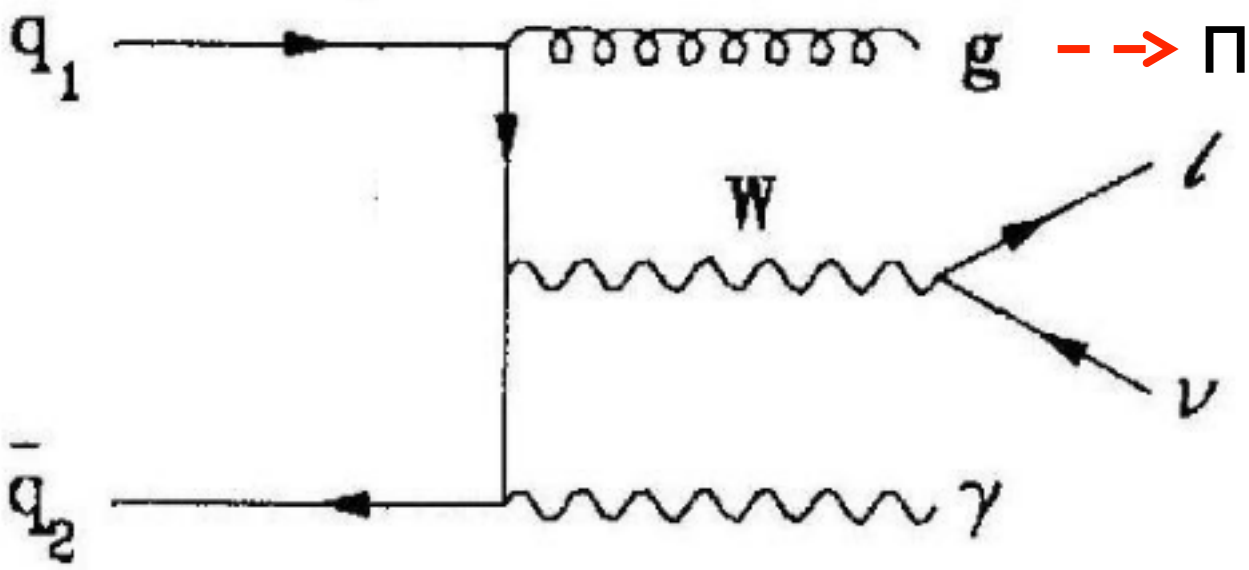
Backgrounds



Background Categories

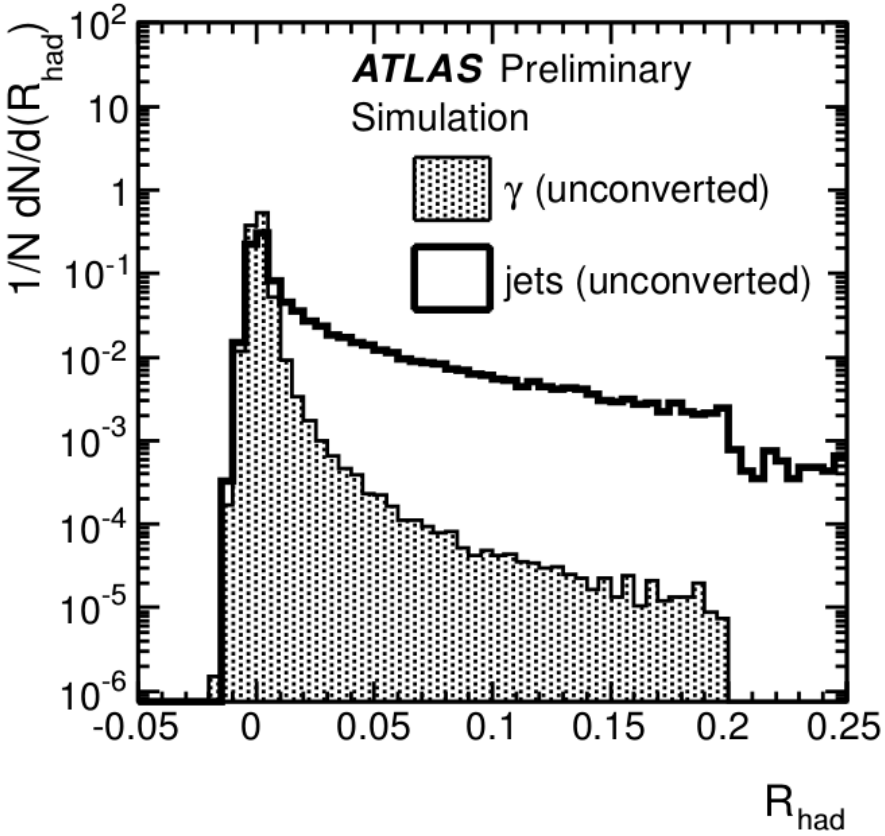


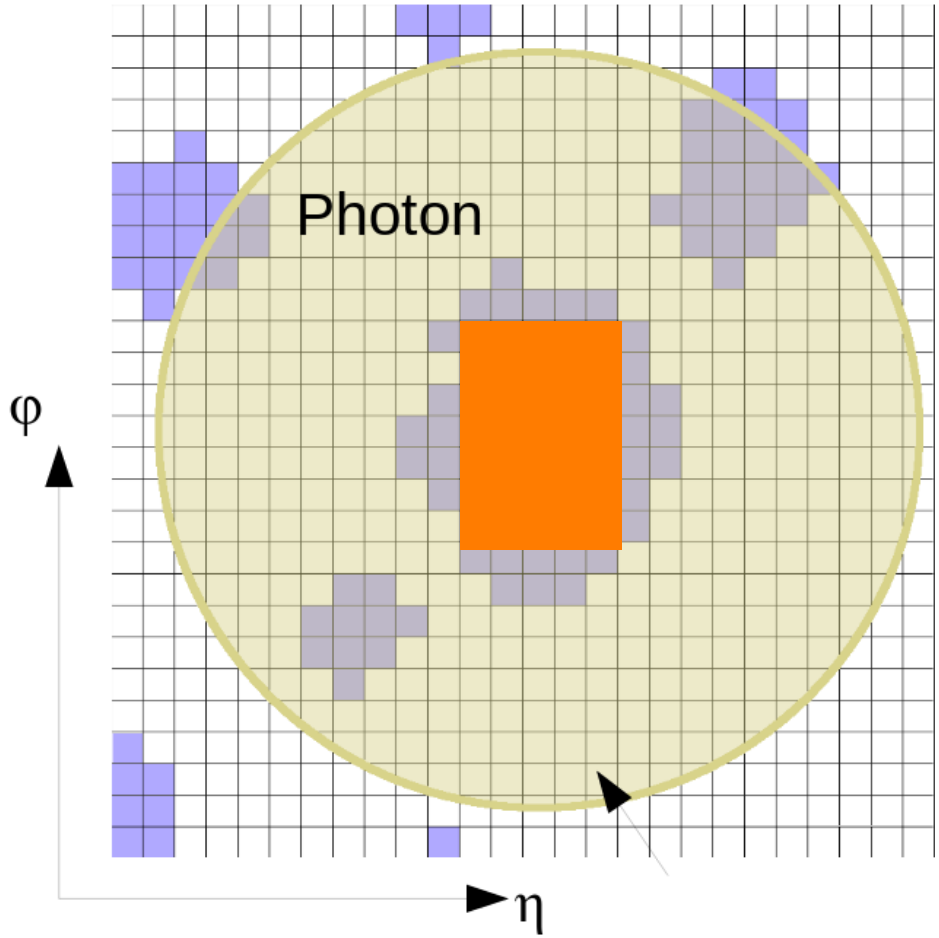
5 %



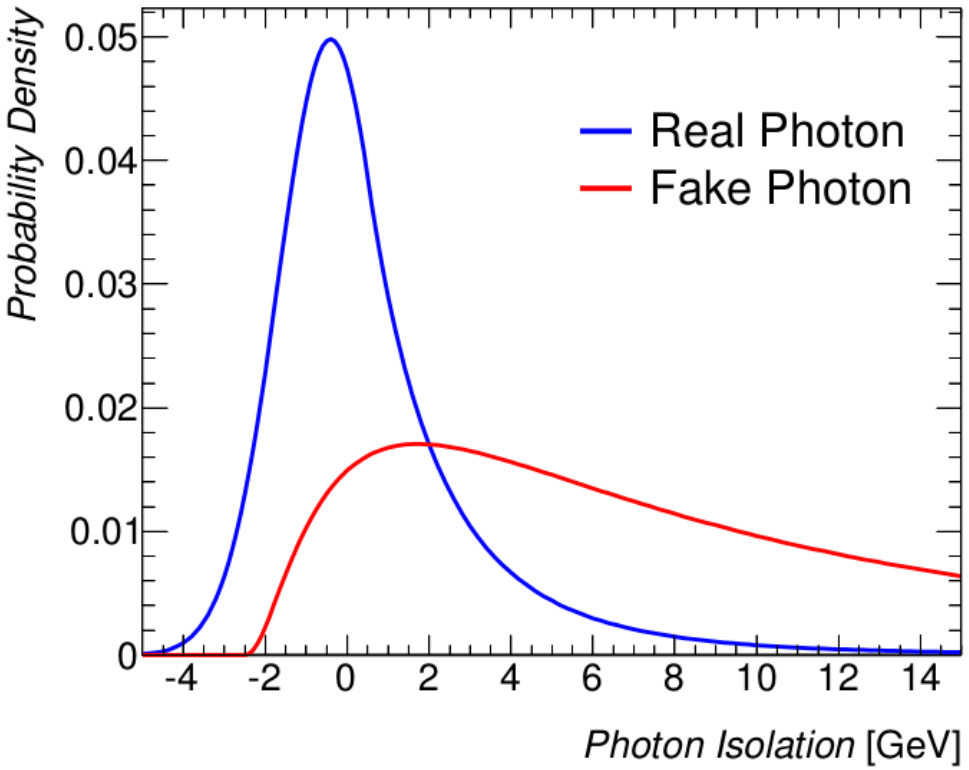
35 %

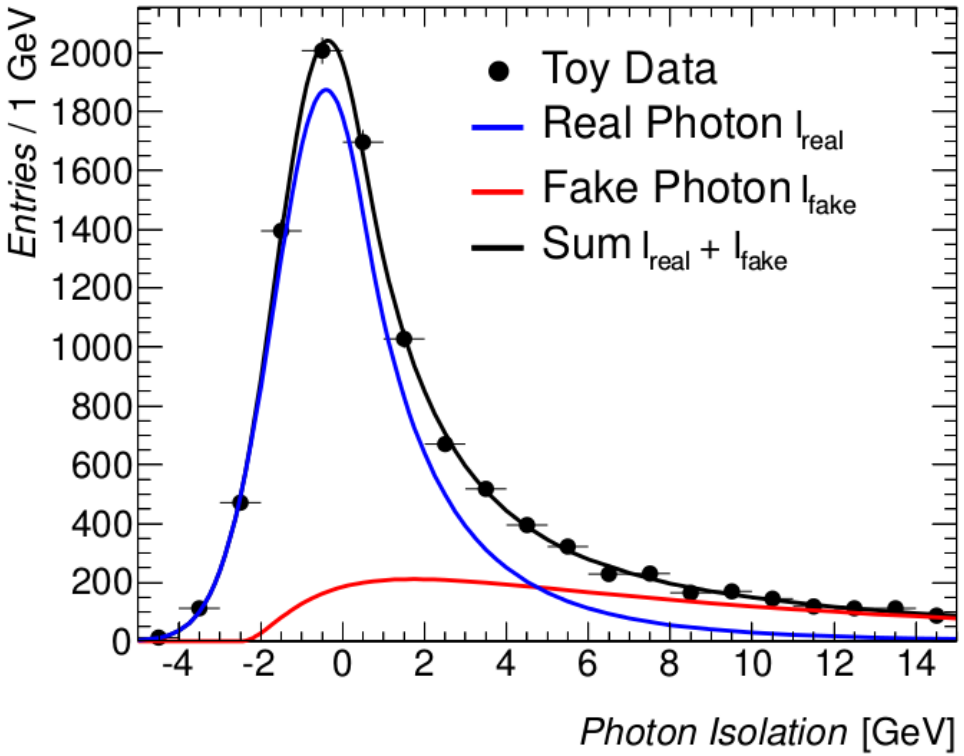
Discriminating Photons





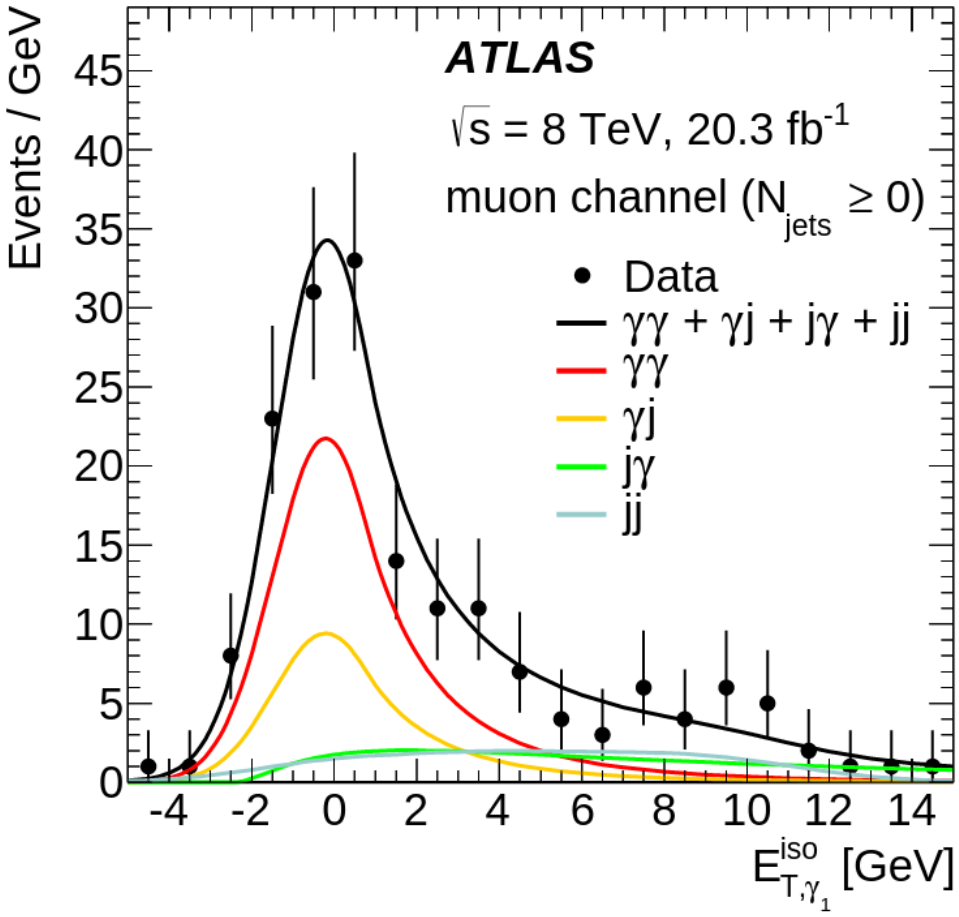
Fake-Photons

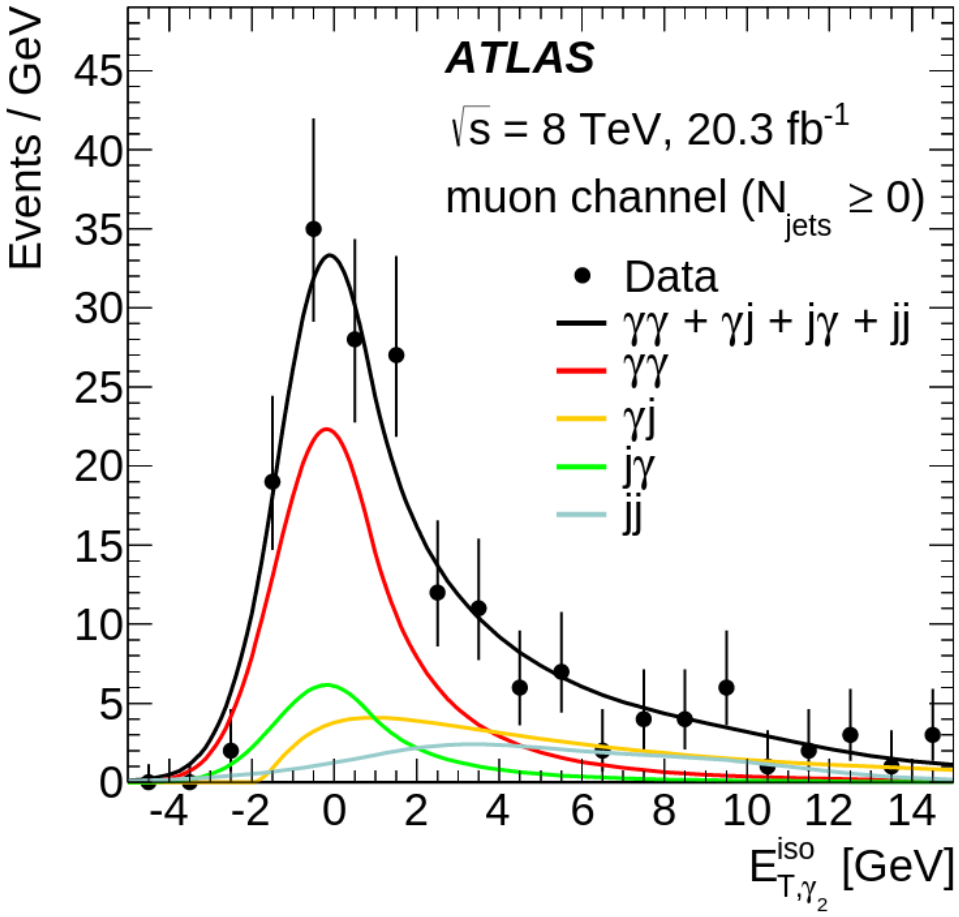




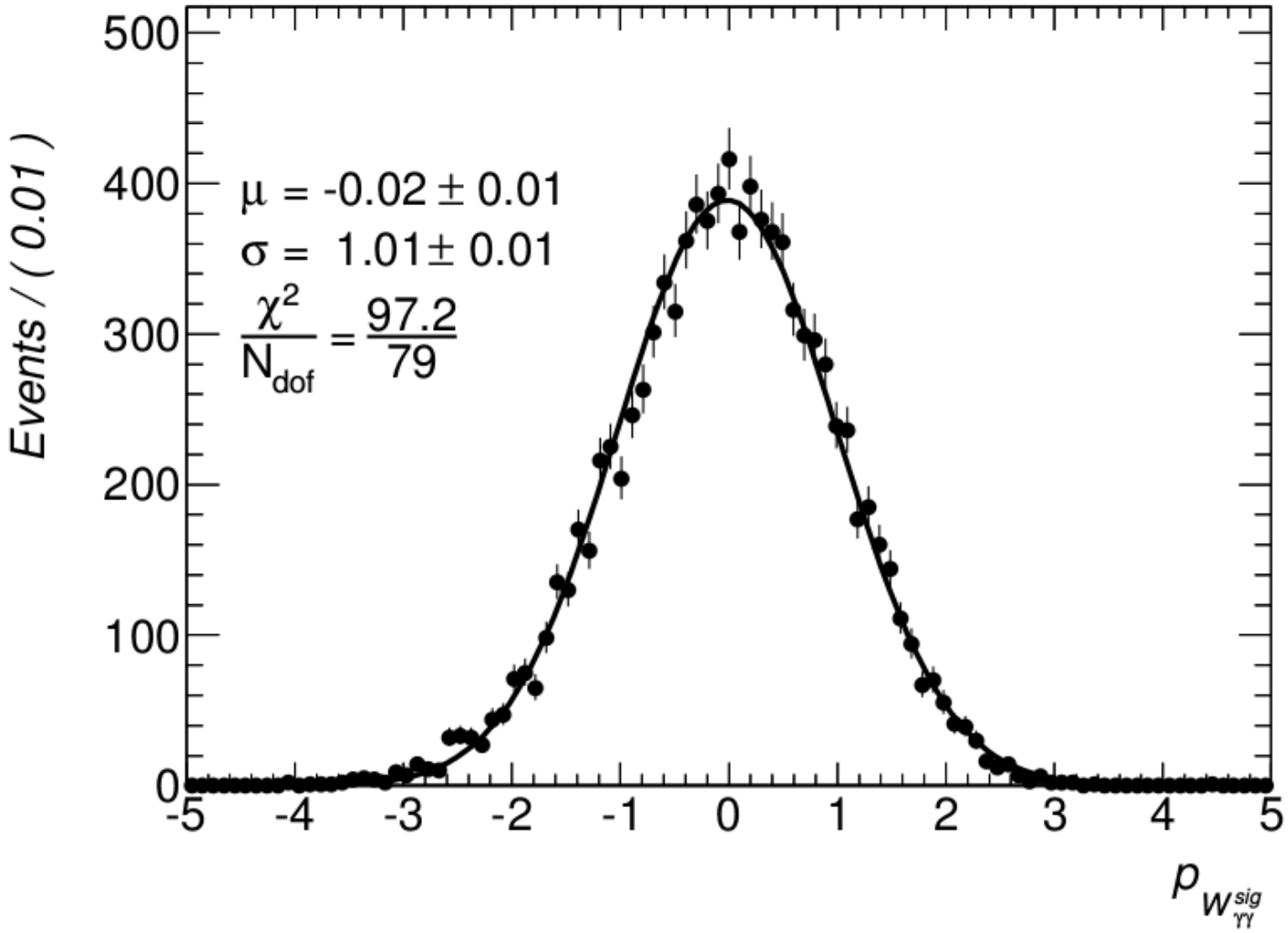
$$L(N_\gamma, N_f \mid \vec{x}) = \left(\prod N_\gamma F_\gamma(x_i) + N_f F_f(x_i) \right) / \mathrm{N}(N_\gamma, N_f)$$

Extension to two photons





Pseudo Experiments



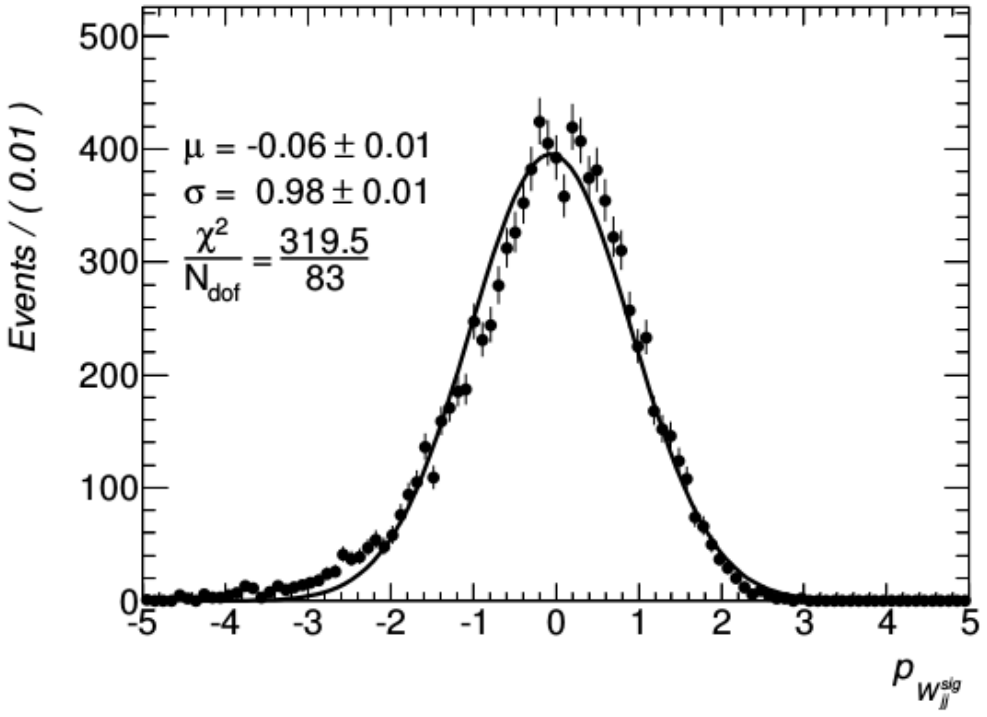
$$p_W = \frac{W_{\mathrm{pe}} - W_{\mathrm{gen}}}{\sigma_{\mathrm{pe}}}$$

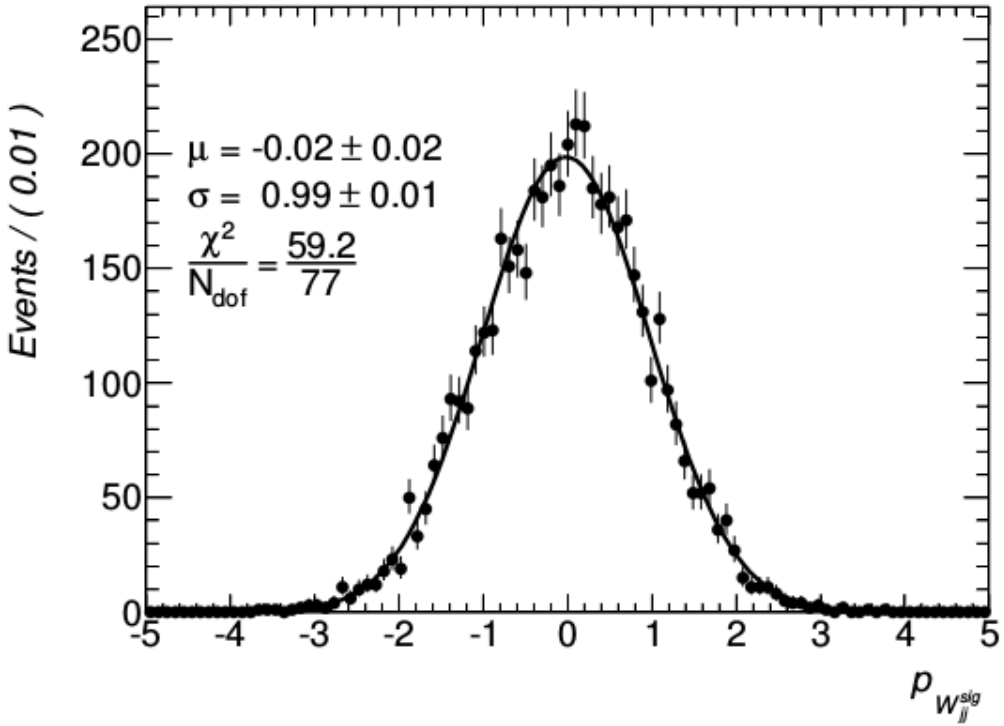
Uncertainties

$$\sigma_N = \sqrt{\sigma^2_{\text{bias}} + \sigma^2_{\text{width}}}$$

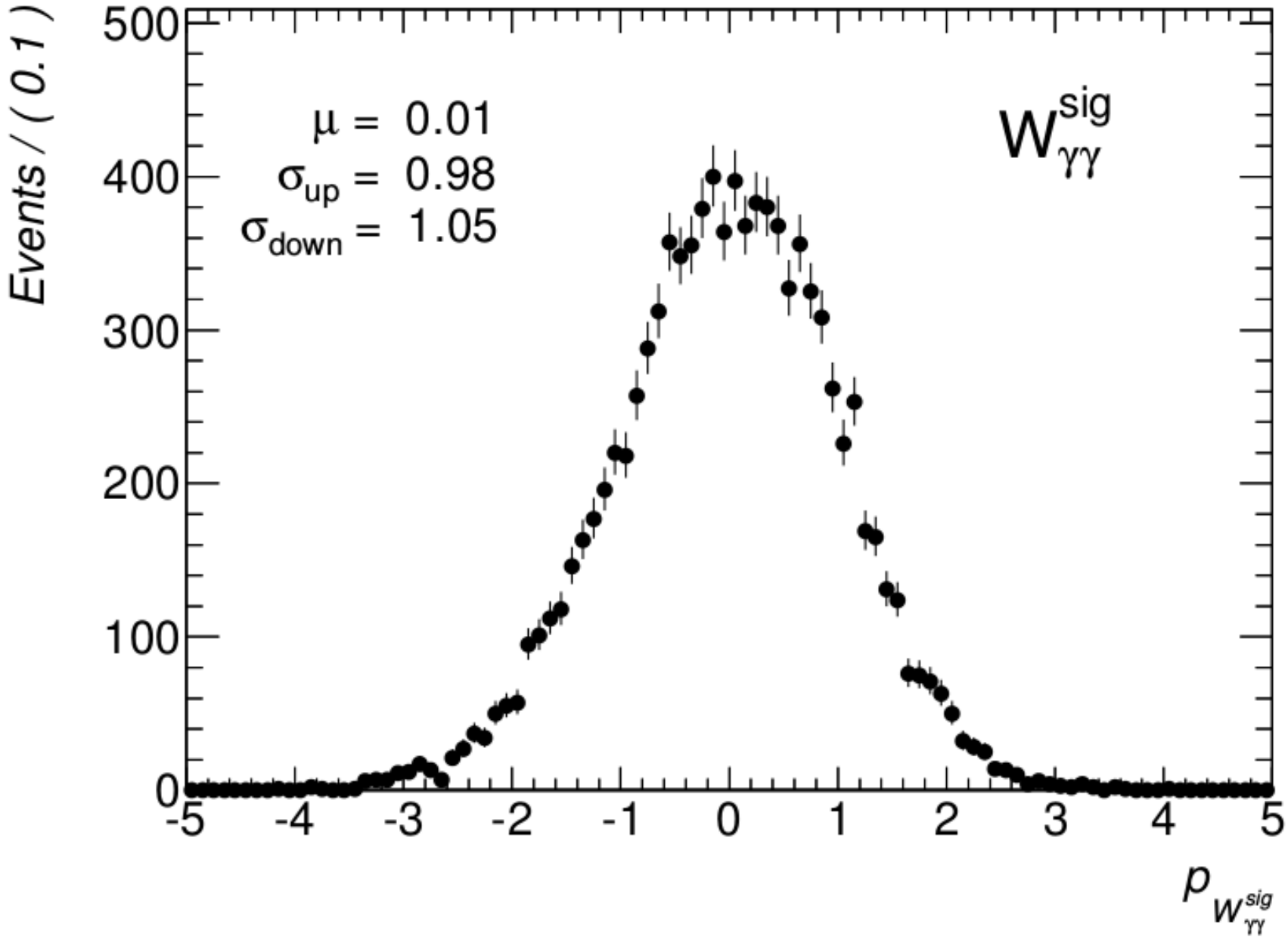
$$\sigma_{\text{bias}} = \mu_{\text{pull}} \cdot \sigma_{\text{fit}} \qquad \sigma_{\text{width}} = \sigma_{\text{pull}} \cdot \sigma_{\text{fit}}$$

Convergence





Systematic uncertainties



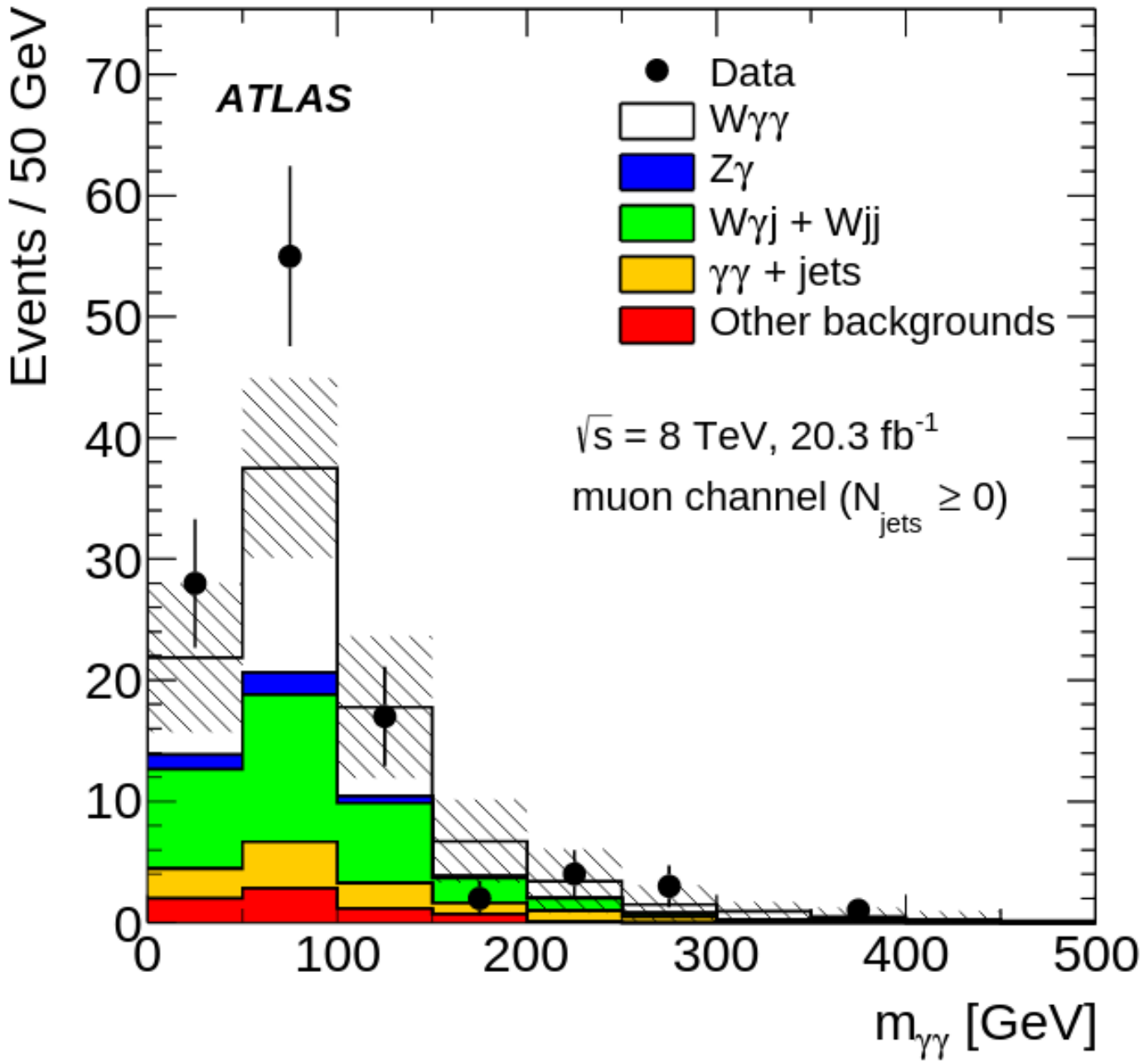
Results

	Muon channel
$W\gamma\mathrm{j} + W\mathrm{jj}$	$30.5 \pm 7.7(\mathrm{stat.}) \pm 6.8(\mathrm{syst.})$
$\gamma\gamma$ + jets	$11.0 \pm 4.0(\mathrm{stat.}) \pm 4.9(\mathrm{syst.})$
$Z\gamma$	$3.9 \pm 0.2(\mathrm{stat.})$
Other backgrounds	$6.7 \pm 2.0(\mathrm{stat.})$
Total background	$52.1 \pm 8.9(\mathrm{stat.}) \pm 8.4(\mathrm{syst.})$
Data	110

Results cross section

	σ^{fid} [fb]	σ^{MCFM} [fb]
Inclusive ($N_{\text{jet}} \geq 0$)		
$\mu\nu\gamma\gamma$	$7.1\ ^{+1.3}_{-1.2}$ (stat.) ± 1.5 (syst.) ± 0.2 (lumi.)	
$e\nu\gamma\gamma$	$4.3\ ^{+1.8}_{-1.6}$ (stat.) $^{+1.9}_{-1.8}$ (syst.) ± 0.2 (lumi.)	2.90 ± 0.16
$\ell\nu\gamma\gamma$	$6.1\ ^{+1.1}_{-1.0}$ (stat.) ± 1.2 (syst.) ± 0.2 (lumi.)	
Exclusive ($N_{\text{jet}} = 0$)		
$\mu\nu\gamma\gamma$	3.5 ± 0.9 (stat.) $^{+1.1}_{-1.0}$ (syst.) ± 0.1 (lumi.)	
$e\nu\gamma\gamma$	$1.9\ ^{+1.4}_{-1.1}$ (stat.) $^{+1.1}_{-1.2}$ (syst.) ± 0.1 (lumi.)	1.88 ± 0.20
$\ell\nu\gamma\gamma$	$2.9\ ^{+0.8}_{-0.7}$ (stat.) $^{+1.0}_{-0.9}$ (syst.) ± 0.1 (lumi.)	

Result Myy


ATLAS
Data
Wγγ
Zγ
Wγj + Wjj
γγ + jets
Other backgrounds
√s = 8 TeV, 20.3 fb-1
muon channel (Njets ≥ 0)
Events / 50 GeV
mγγ [GeV]
0
10
20
30
40
50
60
70
0
100
200
300
400
500