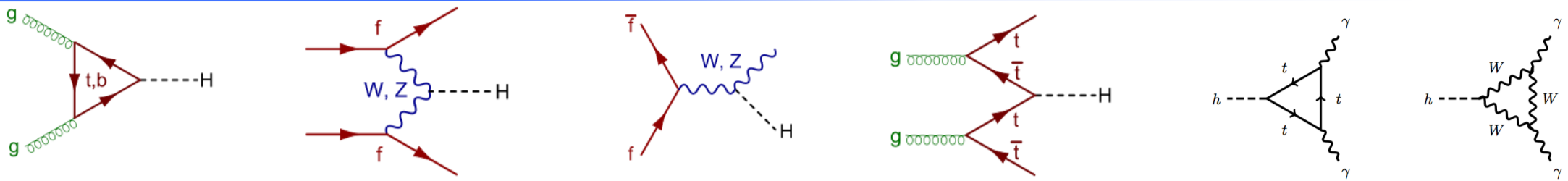


# 140. Measurement of fiducial and differential cross sections in the Higgs Boson Diphoton decay channel using 13 TeV proton-proton collision data with the ATLAS detector

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## Event/object selection

### Event and Photon Selection

- Leading/subleading photons are selected within  $|\eta| < 2.37$  (excluding transition region of barrel and endcap  $1.37 < |\eta| < 1.52$ )
- Leading/subleading photons should pass the tight ID and isolation criteria.
- The diphoton invariant mass  $m^{\gamma\gamma}$  should be in  $[105, 160]$  GeV, and the relative  $p_T$  cut  $p_T^{\gamma 1}/m^{\gamma\gamma}$  must larger than  $0.35(0.25)$  for the two photons.

### Jet selection:

- Jets are reconstructed with the anti- $k_r$  algorithm with distance parameter  $R=0.4$
- The jet transverse momentum must greater than 30 GeV, and jet rapidity  $|y| < 4.4$
- Jets which have  $P_T < 60$  GeV and  $|y| < 2.4$  need further pass JVT cuts, to reduce the jets from pileup vertex in the event.

### Lepton selection:

- The electron transverse momentum must greater than 15 GeV, and  $|\eta| < 2.47$  (excluding transition region of barrel and endcap  $1.37 < |\eta| < 1.52$ ). Fulfill Loose ID.
- The muon transverse momentum must greater than 15 GeV, and  $|\eta| < 2.7$ . Fulfill Medium ID.

## Analysis Strategy

### Fiducial region definition:

- 2 isolated photons with  $|\eta| < 2.37$  exclude crack region (1.37-1.52)
- $P_{T\gamma 1}(P_{T\gamma 2})/M_{\gamma\gamma} > 0.35(0.25)$
- $105 < M_{\gamma\gamma} < 160$  GeV

### Differential variables/ fiducial regions:

Higgs boson kinematic variables:

$$P_T^{\gamma\gamma}, |Y_{\gamma\gamma}|$$

Jet – activity variables:

$$P_T^j, N_{j30} (P_{Tjet} > 30 \text{ GeV})$$

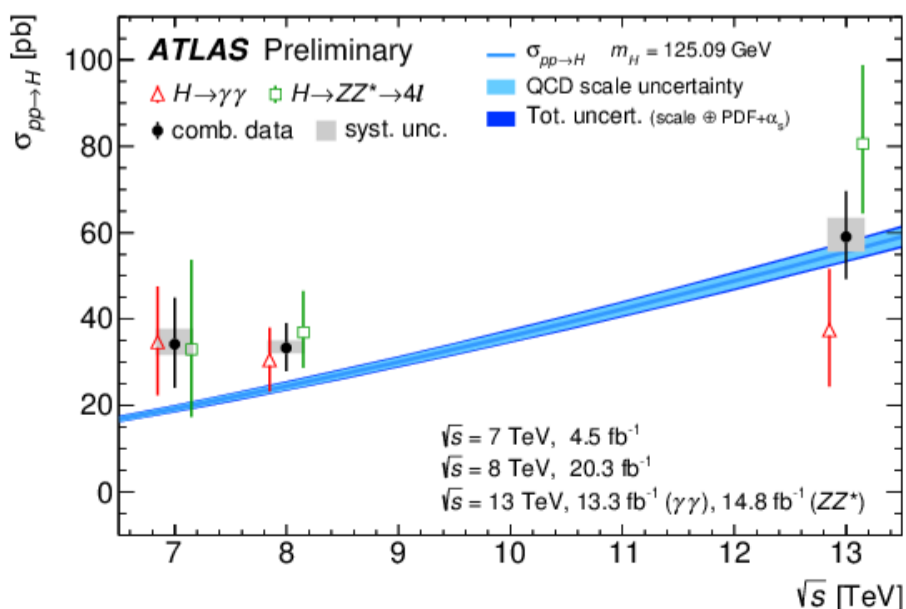
Spin-CP sensitive variables:  $|\cos\theta^*|, |\Delta\phi_{jj}|$

VBF sensitive variables:  $m_{jj}$

Fiducial regions: baseline, H+1-lepton and VBF regions.

### Signal extraction for each variable:

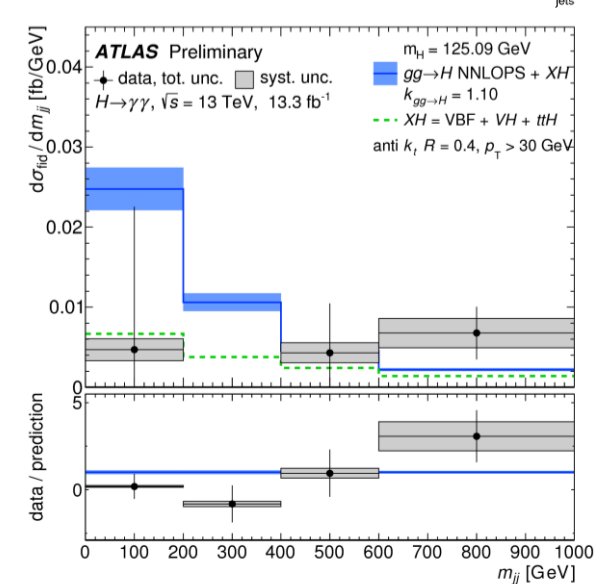
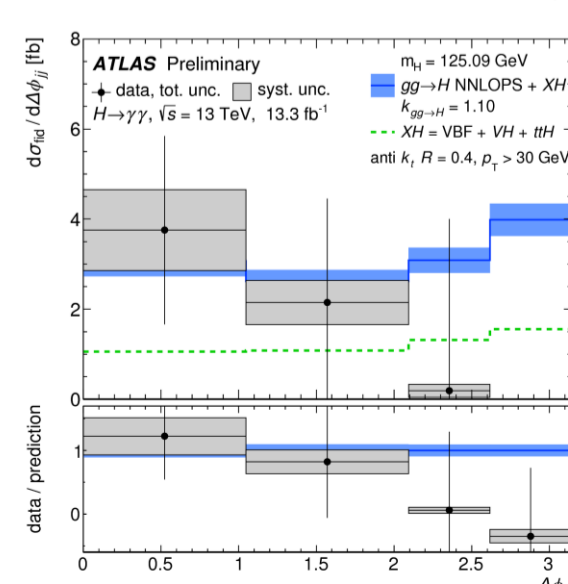
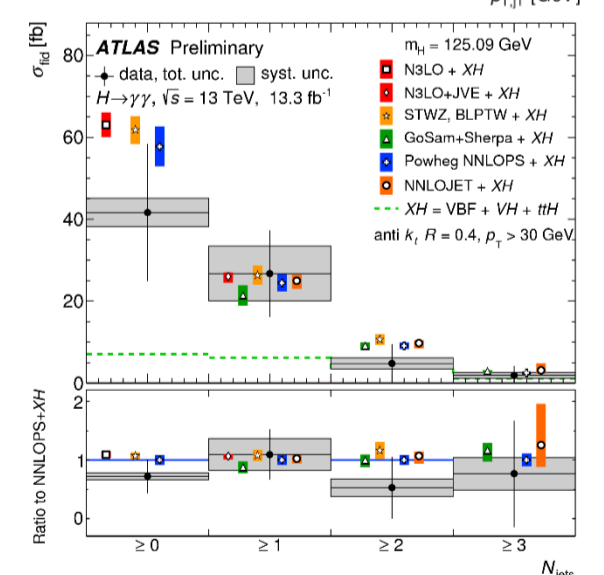
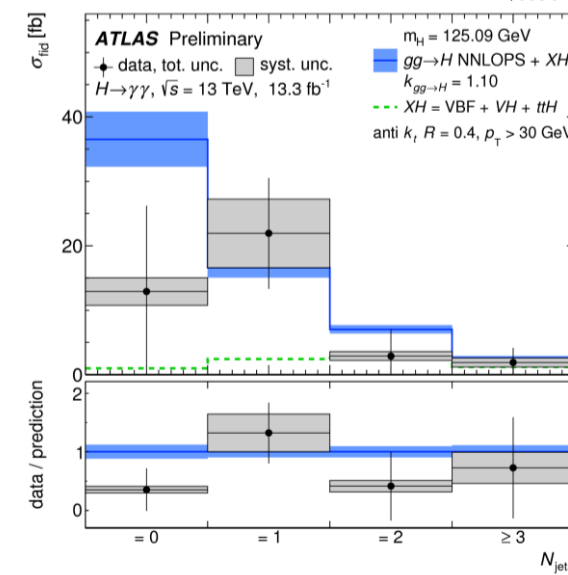
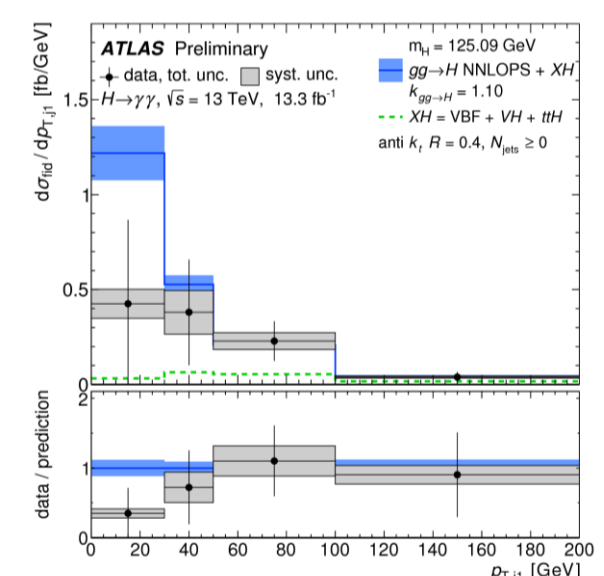
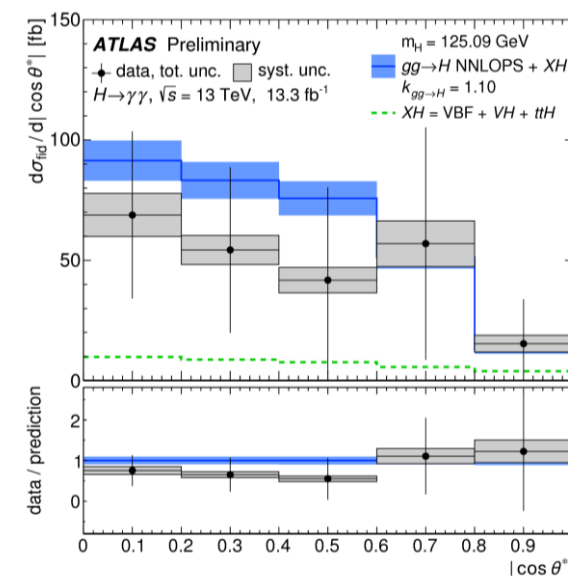
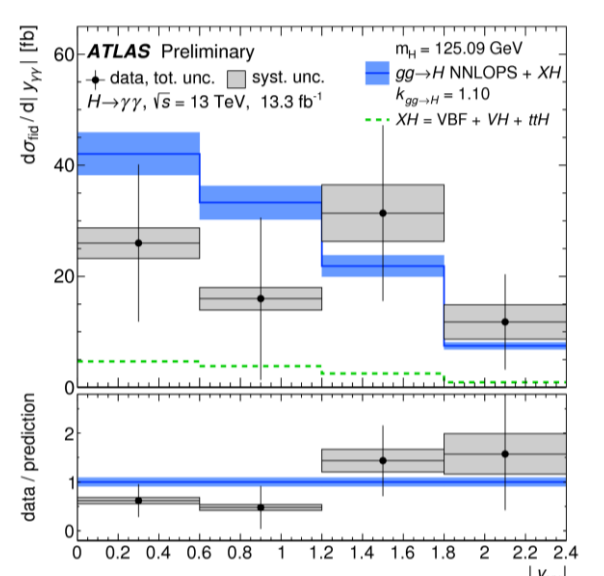
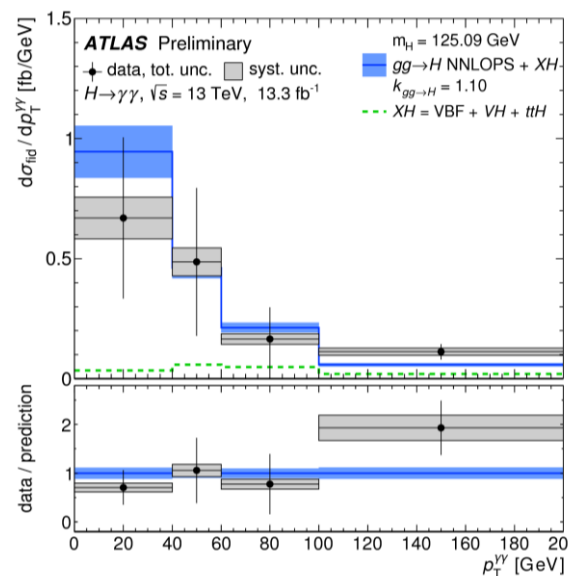
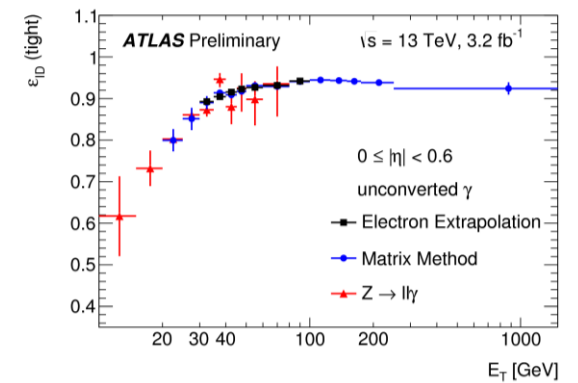
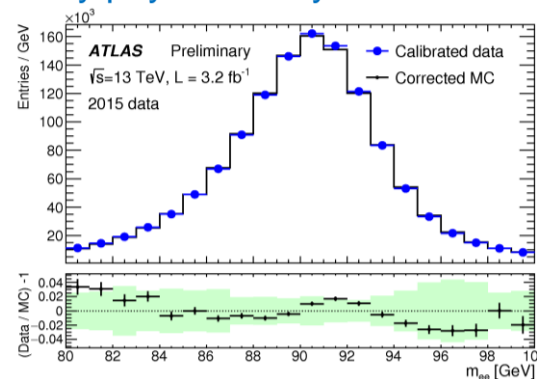
Simultaneous S+B fit to all bins for an observable of interest with the systematics from energy scale (+/- 0.4%) and mH measurement (+/- 0.19%, using ATLAS/CMS combined mass result 125.09 GeV)



## Calibration and PID efficiency of photons

- A precise knowledge of the energy scale and resolution of prompt electrons and photons is an important ingredient to many physics analyses.

- Photon identification efficiency: measurements from three methods good in agreement



**Results: Theoretical prediction is broadly in line with the data.**

Fiducial region	Measured cross section (fb)	SM prediction (fb)
Baseline	$43.2 \pm 14.9$ (stat.) $\pm 4.9$ (syst.)	$62.8^{+3.4}_{-4.4}$ [N <sup>3</sup> LO + XH]
VBF-enhanced	$4.0 \pm 1.4$ (stat.) $\pm 0.7$ (syst.)	$2.04 \pm 0.13$ [NNLOPS + XH]
single lepton	$1.5 \pm 0.8$ (stat.) $\pm 0.2$ (syst.)	$0.56 \pm 0.03$ [NNLOPS + XH]

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