Property measurements of the Higgs boson in the γγ final state with the ATLAS detector at the LHC
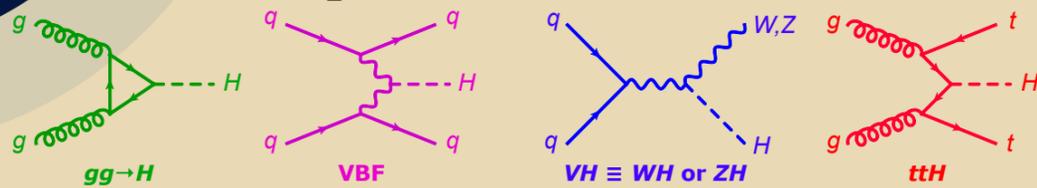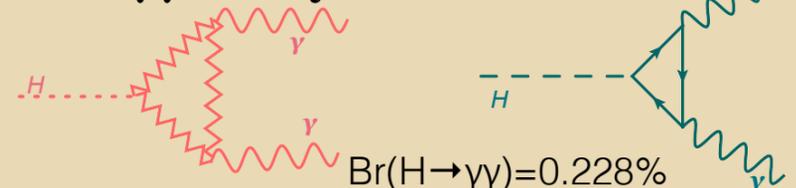
Main SM production modes:

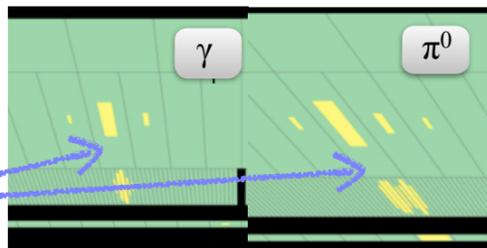**gg→H**   **VBF**   **VH ≡ WH or ZH**   **ttH**

H→γγ decays:

Br(H→γγ)=0.228%

Reconstructing H→γγ @ ATLAS

✦ **Simple topology:**
• 2 isolated energetic photons

✦ **Good discrimination from hadronic background:**
• Shower shapes in EM calorimeter

✦ **Narrow signal peak:**
• Good mass resolution (FWHM ~ 2-5 GeV)

Calibration and PID efficiency of photons

✦ **Calorimeter non-uniformities and layer intercalibration correction**

✦ **EM cluster energy correction via MVA regression**

✦ **E-scale and resolution extracted with Z→ee**

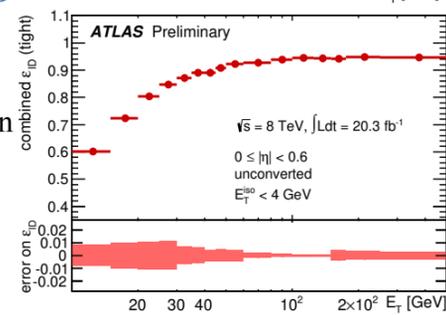• Energy scale uncertainty: 0.03%-0.05% for 40GeV E_T electron, 0.2-0.5% for photons
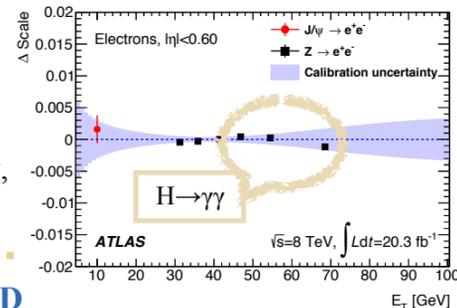
• Energy resolution uncertainty: 10% better resolution for H→γγ, 5-10% for 10-45 GeV electron.

Significant improvement achieved

Mass of the Higgs boson
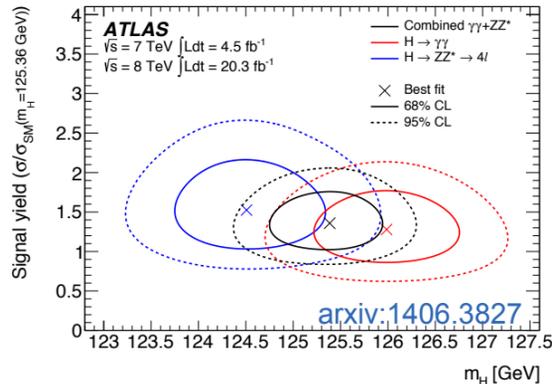
5 Extraction of signal yield and correction for detector effects

values of the underlying Poisson distribution to find n_i events, $m_{\gamma\gamma}^j$ is the diphoton invariant mass for event j ... signal and background probability.

$125(98^{+}_{-}42)$(stat.)(38)(syst)

Previous results in H→γγ: 126.8 ± 0.2(stat.) ± 0.7(syst.)

Channel	PID unc.
	10.8%
	5.3%
	2.4%
	1.0%

methods for PID measurement
m Z→γll
n from electron in
ys
od based on
ty.

Analysis Strategy

✦ **Definition of the Fiducial reg**
• 2 isolated photons with |η|<2.37
• $p_{T\gamma1}(p_{T\gamma2})/m_{\gamma\gamma} > 0.35(0.25)$
• $105<m_{\gamma\gamma}<160$ GeV

✦ **Observables**
• Higgs boson kinematic:
$P_{T\gamma\gamma}$, $|\eta_{\gamma\gamma}|$, P_{Tt}
• Jet activity:
N_{jets}, P_{Tj1}, H_{Tjet}, etc.
• VBF-sensitive variables:
$\Delta\varphi_{\gamma\gamma,jj}$, m_{jj}, P_{THjj}, etc.
• Spin-CP sensitive variables:
$\cos\theta^*$, $\Delta\varphi_{jj}$, Δy_{jj}

✦ **Signal extraction (for each observable)**
• S+B simultaneous fit to all bins for an observable of interest with the Higgs mass fixed to combination measurement.
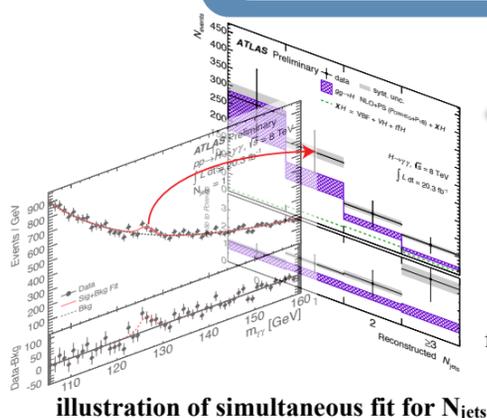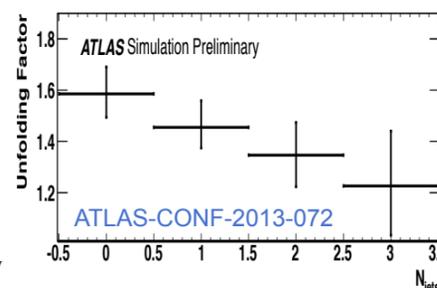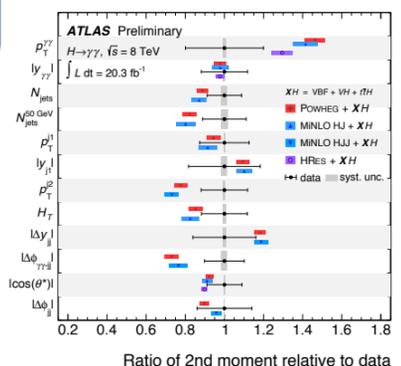
illustration of simultaneous fit for N_{jets}

Fiducial and Differential X-sec measurements

Direct comparison with the state-of-art theoretical predictions

Inclusive
$N_{jets} \geq 1$
$N_{jets} \geq 2$
$N_{jets} \geq 3$
VBF-enhanced
$N_{leptons} \geq 1$
$E_T^{miss} > 80$ GeV

signal yields and the expected yields from simulation are presented in Table 1. The cross section, σ, in a given fiducial region (or bin ...)

Bin-by-bin Correction Factors

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Compatibility

Agreement is quantified: **1st / 2nd moment**

Ratio of 1st moment relative to data

Ratio of 2nd moment relative to data
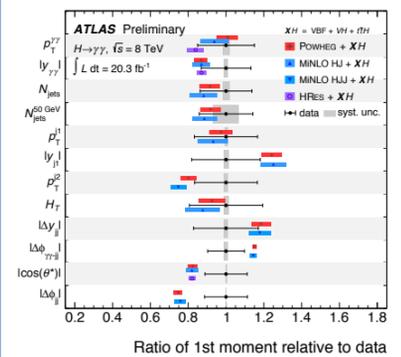
Broadly in line with the theoretical expectations