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 within $[105, 160]$ GeV, and the relative $p_T$ cut $P_{\gamma\gamma} / m_{\gamma\gamma}$ must be larger than 0.35 (0.25) for the two photons.

Jet selection:

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

Lepton selection:

- The electron transverse momentum must be greater than 15 GeV, and $|\eta| < 2.2$.
- The muon transverse momentum must be greater than 15 GeV, and $|\eta| < 2.7$.

Analysis Strategy

Fiducial region definition:

- 2 isolated photons with $|\eta| < 2.37$ exclude crack region ($1.37 - 1.52$).
- $P_{T\gamma_1} / P_{T\gamma_2} > 0.35 (0.25)$.
- $105 < m_{\gamma\gamma} < 160$ GeV.

Differential variables/ fiducial regions:

Higgs boson kinematic variables:

$P_{T\gamma} / m_{\gamma\gamma}$

Jet – activity variables:

$P_{Tj} N_{\geq 30}$ ($P_{Tj} > 30$ GeV)

Spin-CP sensitive variables:

$|\cos \theta^*|, |\Delta \varphi_{jj}|$

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 $m_H$ measurement (+/- 0.19%), using ATLAS/CMS combined mass result 125.09 GeV

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