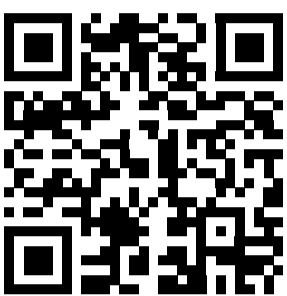


EPS-HEP 2017 Poster Session

First measurement of isolated-photon plus jet production in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector



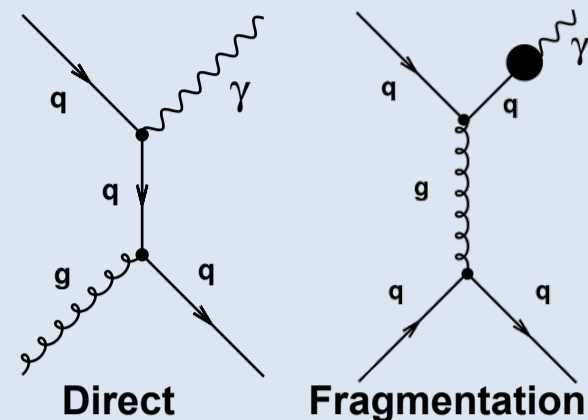
Introduction

In pp collisions, high E_T^γ photons can be produced via two mechanisms:

- **Direct process:** photon coming from the hard interaction
- **Fragmentation process:** photon coming from the fragmentation of a parton which is produced in the hard interaction.

Measurements of photon plus jet production allow to:

- test of perturbative QCD predictions;
- constrain the gluon PDF;
- aid BSM searches involving photons.



Photon reconstruction

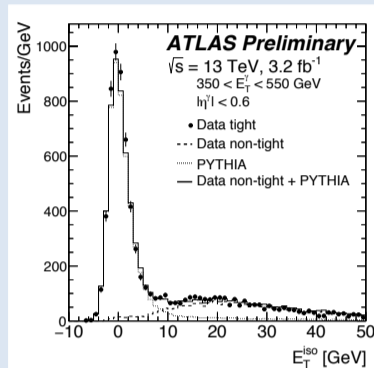
Unconverted photon candidate \rightarrow no match with any track.

Converted photon candidate \rightarrow match with conversion vertex.



Photon Isolation

E_T^{iso} is computed by summing the transverse energy of clusters of calorimeter cells in a cone of radius $R=0.4$ centered on the photon, excluding its contribution.



Fiducial phase-space

2015 data $\mathcal{L} = 3.2 \text{ fb}^{-1}$

Photons

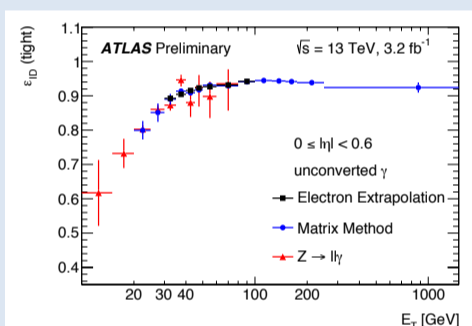
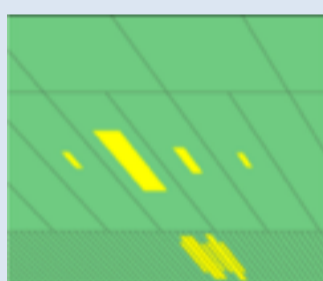
- $E_T^\gamma > 125 \text{ GeV}$;
- $|\eta^\gamma| < 2.37$
- ($1.37 < |\eta^\gamma| < 1.56$ excluded);
- $E_T^{iso} < 4.2 \cdot 10^{-3} \cdot E_T^\gamma + 10 \text{ GeV}$.

Jets

- Anti- k_t ($R=0.4$) ;
- $P_T^{jet} > 100 \text{ GeV}$;
- $|y^{jet}| < 2.37$;
- $\Delta R^{\gamma-jet} > 0.8$.

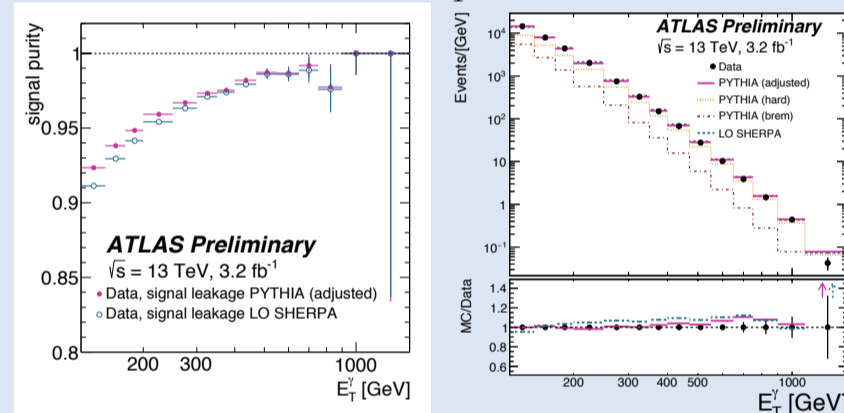
Photon Identification

The main background sources are π^0 and η two photons decay. Two photon identification criteria ("Loose" and "Tight") are introduced based on the shower shapes in the ATLAS calorimeter system.

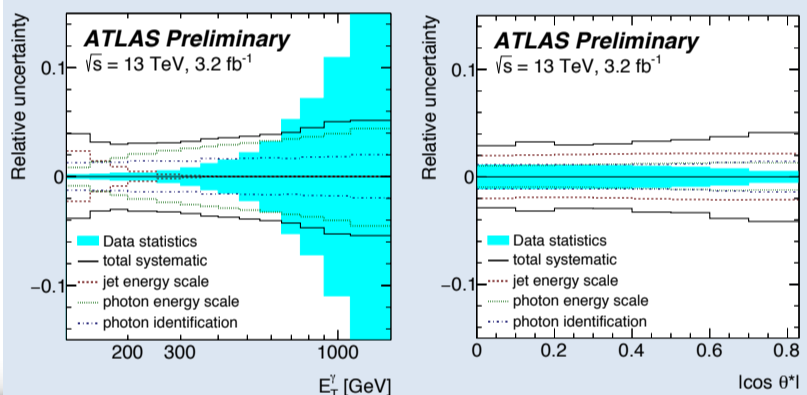


Background subtraction and signal yields

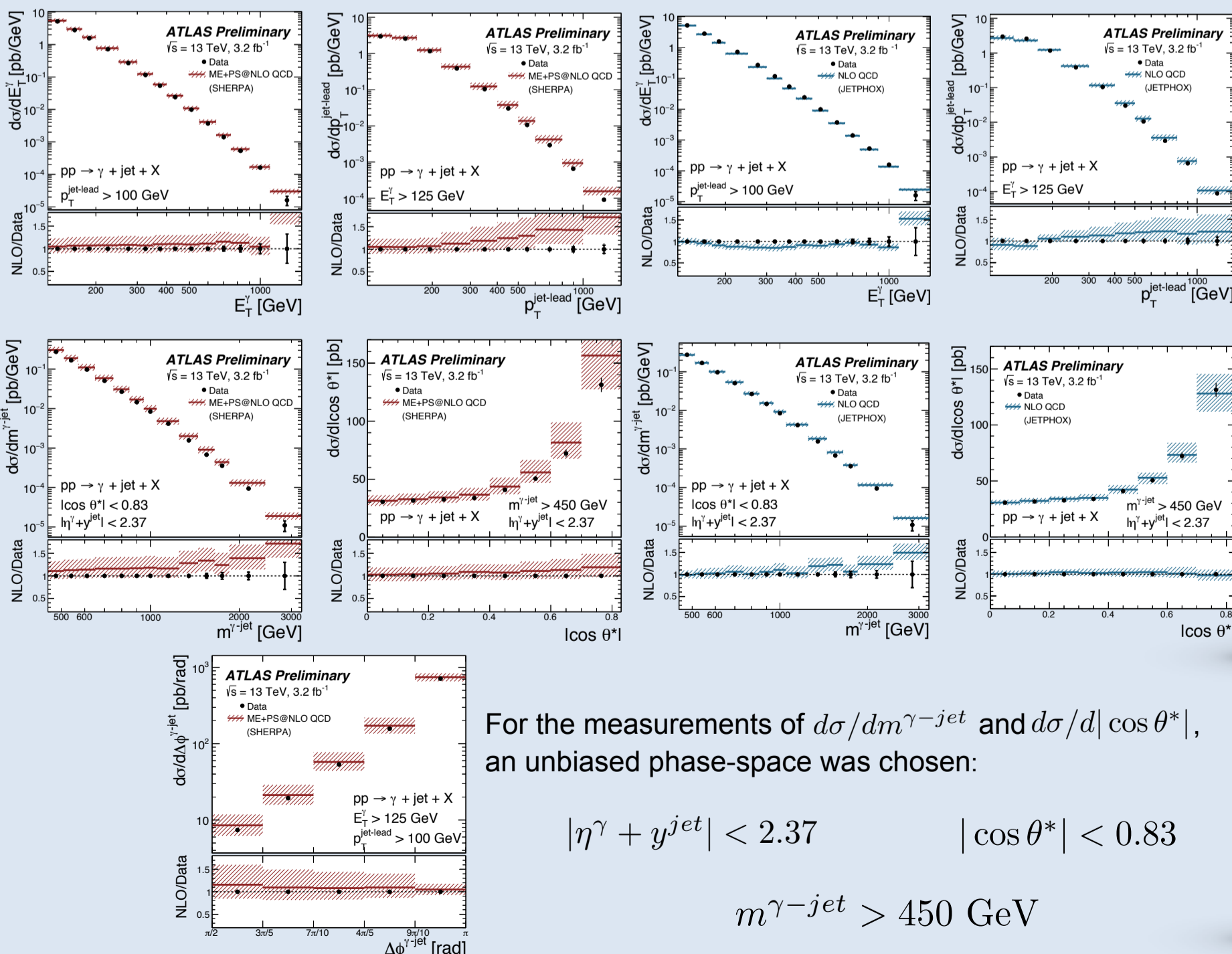
Background was subtracted using a data-driven method based on a "2D-sideband" method applied in the $E_T^{iso} - \gamma^{ID}$ plane.



Systematic uncertainties



Results



For the measurements of $d\sigma/dm^{\gamma-jet}$ and $d\sigma/d|\cos\theta^*|$, an unbiased phase-space was chosen:

$$|\eta^\gamma + y^{jet}| < 2.37 \quad |\cos\theta^*| < 0.83$$

$$m^{\gamma-jet} > 450 \text{ GeV}$$

NLO QCD calculations

\rightarrow Fixed-order NLO QCD predictions from *JETPHOX* for both direct and fragmentation contributions.

- MMHT2014 proton PDFs and BFG set II photon fragmentation functions.
- Corrected for non-perturbative effects.

\rightarrow Multi-leg NLO QCD plus parton-shower predictions from *SHERPA* for direct contribution:

- $\gamma + 1,2$ jets at NLO and $\gamma + 3,4$ jets at LO;
- NNPDF3.0NNLO proton PDF.

Theoretical uncertainties: Scale variations, PDFs and α_s .

Summary and conclusions

- Measurement of the differential cross sections for $\gamma + jet$ as function of E_T^γ , P_T^{jet} , $\Delta\phi^{\gamma-jet}$, $m^{\gamma-jet}$ and $|\cos\theta^*|$.
- Values up to 1.5 TeV accessible for E_T^γ and P_T^{jet} .
- $d\sigma/dm^{\gamma-jet}$ measurement from 0.45 TeV and 3.25 TeV.
- $d\sigma/d|\cos\theta^*|$ increases as $|\cos\theta^*|$ increases in agreement with the NLO expectations.
- The NLO QCD predictions of *JETPHOX* and *SHERPA* describe the data within the theoretical uncertainties.

Bibliography

- [1] ATLAS Collaboration, Nucl. Phys. B 875 (2013) 483
- [2] ATLAS Collaboration, ATL-PHYS-PUB-2016-014
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- [4] ATLAS Collaboration, Phys. Lett. B 770 (2017) 473
- [5] ATLAS Collaboration, ATL-CONF-2017-059

