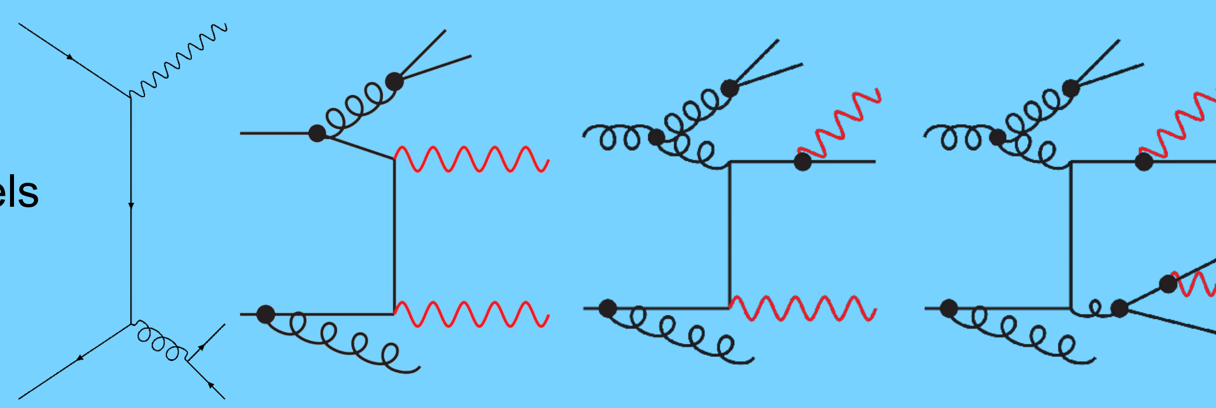
ISMD22 Poster Session

Precision measurements of jet and photon production at the ATLAS experiment

Introduction

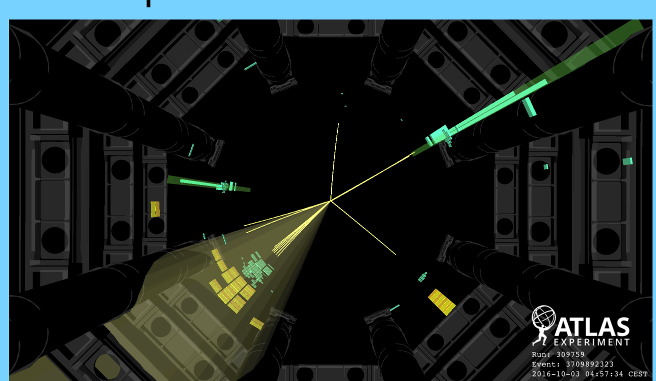
The prompt photons and jets production at hadron colliders provides:
- Tests of perturbative QCD predictions
- Constrains on the gluon PDF
- Inputs to MC tuning for both hadronisation and parton shower models
- Improvements for BSM searches involving photons
- Sensitive measurements of the multi-jet energy flow and the strong coupling constant

Measurements of γ +jets and diphoton production are presented



ATLAS detector

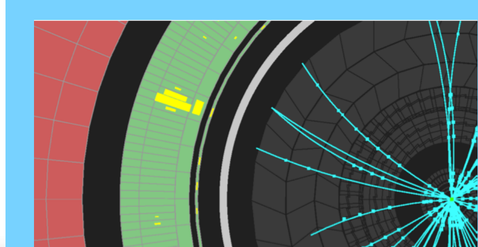
Diphoton event candidate



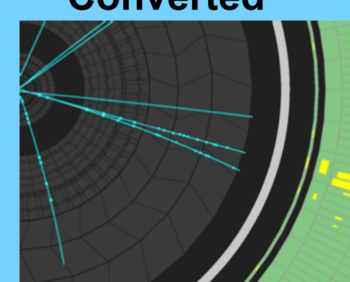
Photon reconstruction

Unconverted photon → no match with any track
Converted photon → match with conversion vertex

Unconverted

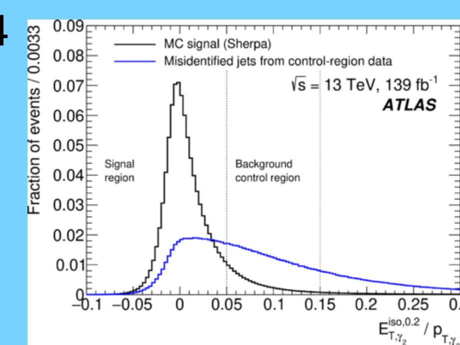


Converted



Photon Isolation

Computed by summing the transverse energy of clusters of calorimeter cells in a cone of R=0.4



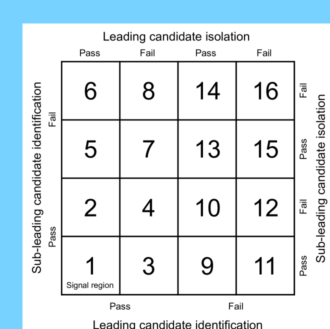
Photon Identification

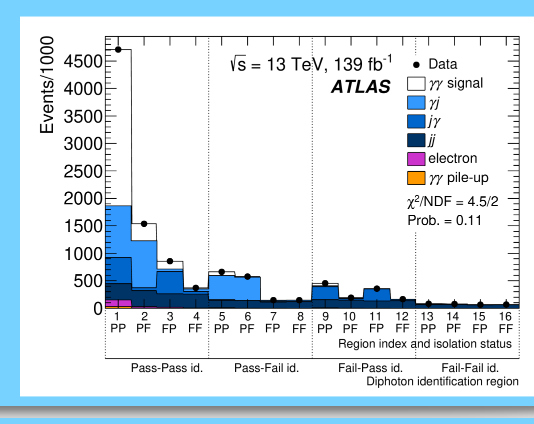
Main background sources coming from decays of neutral hadrons into photons. The "loose" and "tight" identification criteria are introduced based on the shower shapes in the ATLAS calorimeter system

Background subtraction

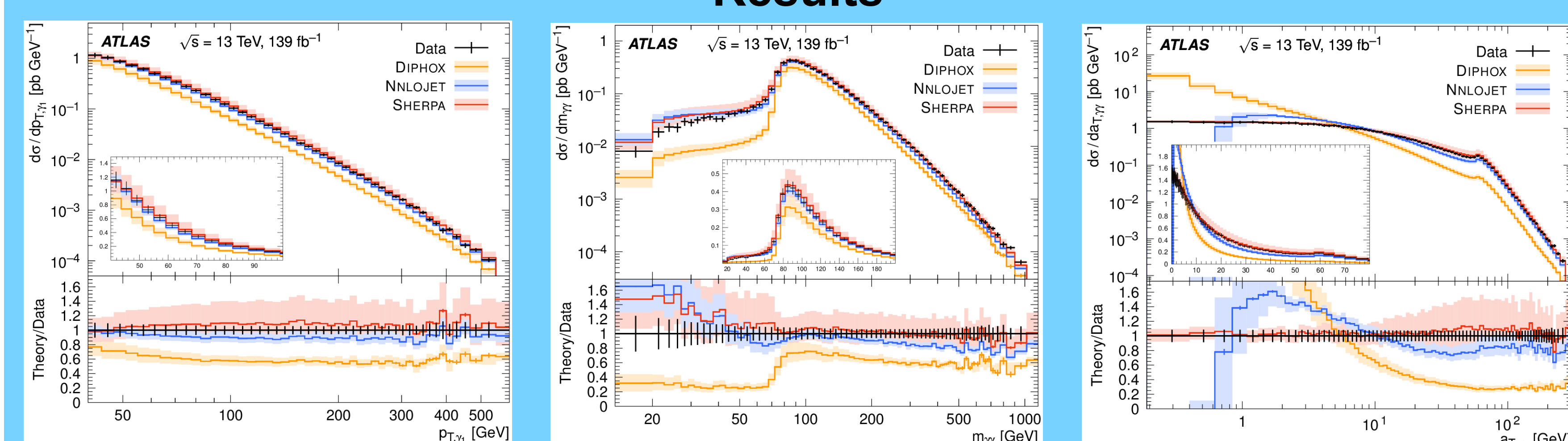
A data-driven method, based on the photon identification and isolation criteria of both photons is deployed to assess the neutral hadron background

γ +jets adopted a similar strategy





Results

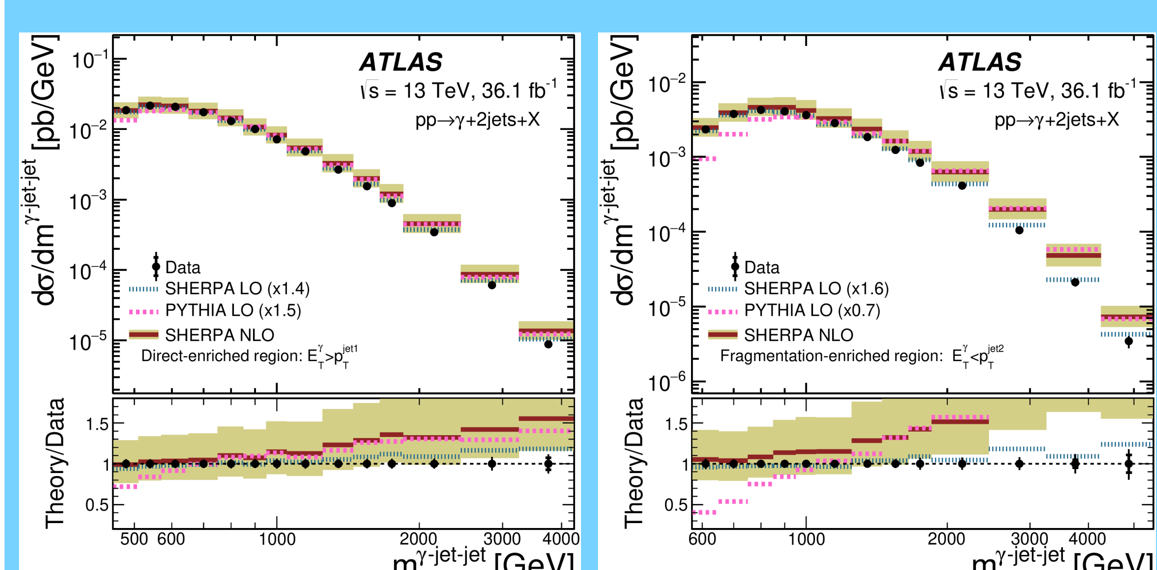


$a_{T,\gamma\gamma}$: transverse component of $p_{T,\gamma\gamma}$ with respect to the thrust axis

Very good modelling of the perturbative regions by the most precise perditions at NNLO and multi-leg merged NLO

Fixed-order predictions of DIPHOX and NNLOJET are not expected to be valid in regions dominated by multiple collinear and soft QCD emissions (e.g. low $p_{T\gamma\gamma}$)

$m_{\gamma\gamma}$ distribution governed by the p_T requirements on the individual photons (40 GeV and 30 GeV, respectively). γγ+multi-jet configurations are dominant in the $m_{\gamma\gamma}$ < 70 GeV region



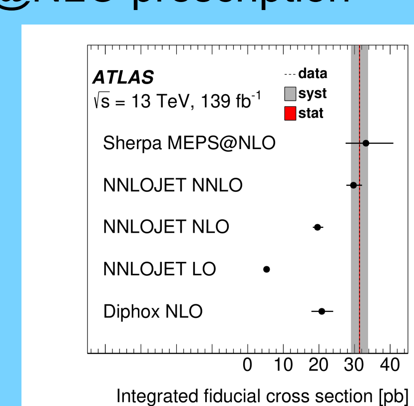
Direct-enriched **Fragmentation-enriched**

Direct and fragmentation enriched phase-spaced regions can be studied by requiring $E_{T}^{\gamma} > p_{T,jet1}$ and $E_{T}^{\gamma} > p_{T,jet2}$, respectively

General good agreement between the data and the SHERPA LO and NLO predictions

Theoretical calculation

The results are compared to the state of the art predictions:
- Fixed-order NNLO with NNLOJET
- Fixed-order NLO with Diphox
- Multi-leg SHERPA 2.2 using the MEPS@NLO prescription



Summary

Run2 measurements of photons and jets production by the ATLAS collaboration are presented

Impressive improvements are observed when taking into account higher-order terms in perturbative QCD

Multi-leg merged prediction yields to larger uncertainties, but they are in better agreement with the data in all regions

Looking forward to having new exiting results in Run3!

Bibliography

[1] ATLAS collaboration, JHEP 03 (2020) 179
[2] ATLAS collaboration, JHEP 11 (2021) 169

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