Measurement of the transverse momentum distribution of Drell-Yan lepton pairs in proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

Introduction and Motivation

- Measurement of the integrated and normalized differential cross-section for Drell-Yan lepton pair production in bins of p_T and $\phi_\eta^* = \tan\left(\frac{\pi - \Delta\varphi}{2}\right)\sin(\theta_\eta^*)$ with θ_η^* the scattering angle in the Z boson rest frame and $\Delta\varphi$ the azimuthal angle between the leptons
- Performed in the electron and muon decay channel
- Crucial to tune MC generators and measure W boson mass
- 36 fb^{-1} of data collected in 2015 and 2016 at 13TeV in proton-proton collisions with the ATLAS detector used for this analysis

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Analysis strategy

- Count events and subtract background distributions
- Dedicated Monte Carlo samples are used to estimate most of the backgrounds, while multijet contributions are estimated with a data-driven approach
- Apply bayesian iterative unfolding with 4 iterations to minimize model- and statistical uncertainties
- Study both systematic and statistical uncertainties
- Measure the normalized cross-section by dividing the distributions by the fiducial cross-section

Event selection

Lepton selection

- $p_{T,\ell} > 27$ GeV
- $|\eta_\ell| < 2.5$
- $|d_0/\sigma(d_0)| < 3$
- $|z_0 \cdot \sin(\theta)| < 0.5$ mm
- Isolation requirement for leptons

Event selection

- High p_T lepton trigger
- Two oppositely charged leptons in event

Boson selection

- $66 < m^{\ell\ell} < 116$ GeV

Measurement of the integrated cross-section

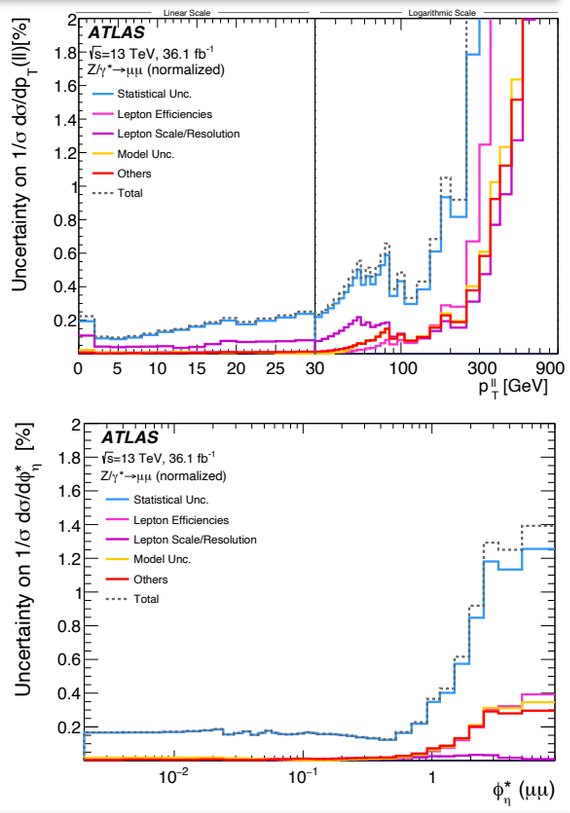
- Measured in fiducial region defined by $p_{T,\ell} > 27$ GeV, $|\eta_\ell| < 2.5$ and $66 < m^{\ell\ell} < 116$ GeV

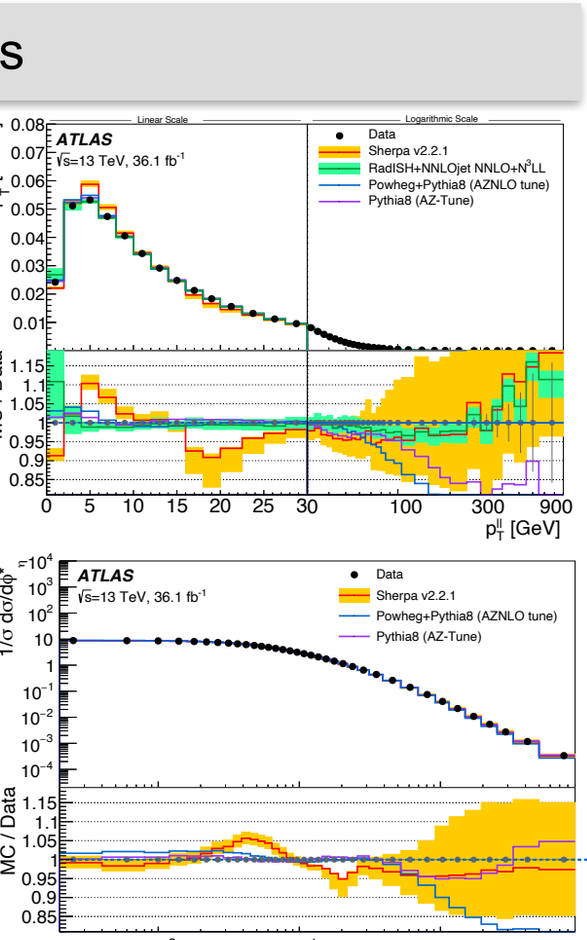
$$\sigma_{fid} = \frac{N_{events} - N_{Background}}{\mathscr{L} \cdot C_Z} \text{ with } C_Z = \frac{N_{events}^{\text{detector level}}}{N_{events}^{\text{particle level}}}$$

Channel	Integrated cross-section (value, stat, syst, lumi)
Muons	$738.3 \pm 0.2 \pm 7.7 \pm 15.5$ pb
Electrons	$731.7 \pm 0.2 \pm 11.3 \pm 15.3$ pb
Combined	$736.2 \pm 0.2 \pm 6.4 \pm 15.5$ pb
Prediction	$703^{+19}_{-24}{}^{+6}_{-8}{}^{+4}_{-6}{}^{+5}_{-5}$ pb

Uncertainties

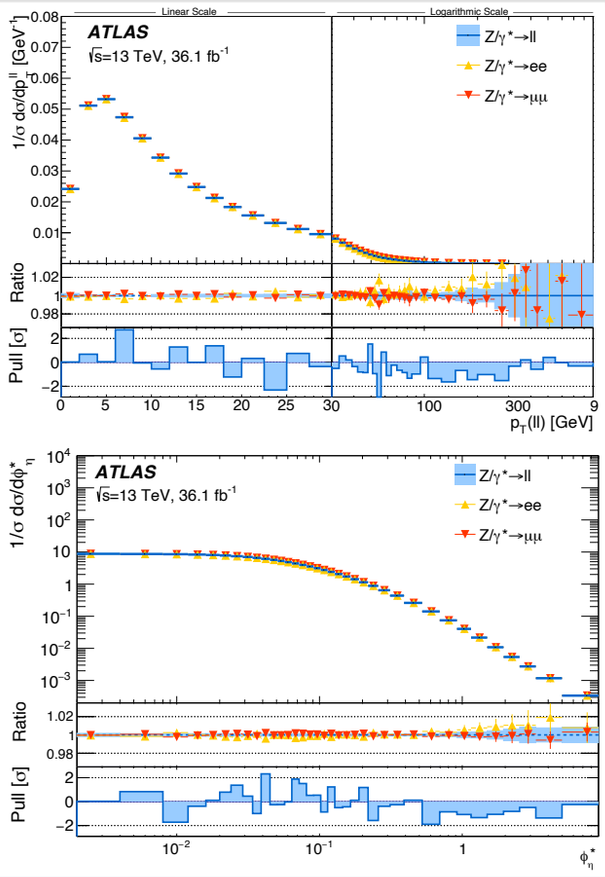
- One of the most precise measurements within ATLAS
- Most uncertainties cancel out in the normalized distribution
- Statistical uncertainties dominate in all bins
- A precision of 0.2% for bins below 30 GeV is achieved





Combined differential results and comparison to predictions

- Combine both channels using minimization, following the best linear unbiased estimator prescription (BLUE)
  - Excellent agreement observed
- Unfolded data are compared to generator predictions
- Generators include Powheg, Pythia8, Sherpa and RadISH.
- For p_T, Powheg+Pythia8 and Pythia8 model the lower bins very well, while Sherpa better describes the high bin regime, The RadISH prediction is in good agreement over all bins.
- For ϕ_η^*, Pythia8 models the full spectrum quite well, while the lower bins are better described by Powheg+ Pythia8 and the higher bins by Sherpa.



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