Measurement of the $tt$ cross-section and $tt/Z$ cross-section ratio using LHC Run 3 $pp$ collision data at a centre-of-mass energy of $\sqrt{s} = 13.6$ TeV

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**MOTIVATION**

The top quark is the most massive known elementary particle. It may play a special role in the electroweak symmetry breaking. The measurement of the production cross-section provides a stringent test of QCD calculations with heavy quarks and opens a window to potential new physics.

This analysis:
- Uses the first data-set available from Run 3 – 1.2 fb\textsuperscript{-1} \[.1\].
- Provides valuable input to validate the functionality of the detectors and the reconstruction software.
- Exploits the $tt/Z$ cross-section ratio to reduce luminosity uncertainty.
- Fiducial Z cross section, with $m_{\ell\ell} > 40$ GeV.
- Contributes to PDFs constraints.

**ANALYSIS STRATEGY**

- **Dilepton channel**
  - Using "b-tag counting" method in the $\ell\ell$ channel
  - In-situ tagging efficiency calibration
  - Low dependence on jet uncertainties
  - Smaller background w.r.t. single lepton
  - Low lepton fakes – can use MC
  
  \[N_1 = L_{t \bar{t} e\mu}(1 - C_{b\ell\ell}) + N_{bkg}^{1b}\tag{1}\]
  \[N_2 = L_{t \bar{t} e\mu} C_{b\ell\ell} + N_{bkg}^{2b}\tag{2}\]

- **Dilepton selection – $e\mu$**
  - 2 opposite-sign leptons $\rightarrow$ one electron and one muon with $p_T > 27$ GeV
  - Lepton fakes background estimated from MC
  - Only events with 1 or 2 $b$-jets are used (DL1d@77\% [2,3])

- **Dilepton selection – $ee/\mu\mu$**
  - 2 opposite-sign leptons $\rightarrow$ same-flavour with $p_T > 27$ GeV
  - BS $> m_{\ell\ell} > 116$ GeV
  - Lepton fakes background estimated from MC

**RESULTS**

- **ATLAS Preliminary**
  - Data + stat.
  - Exp. + stat.
  - Data + stat. uncer.
  - Exp. only
  - SL only

**SUMMARY**

- The large luminosity uncertainty limits the precision of the inclusive cross section
- In the $tt/Z$ ratio the luminosity uncertainty cancels out to a large extent
- The measured values are consistent with the prediction at one standard deviation

More information at:

**REFERENCES**

1. ATLAS-CONF-2022-070
3. ATL-PHYS-PUB-2020-014

1. INFN Trieste, Gruppo Collegato di Udine
2. Universitè degli studi di Trieste