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Differential cross section measurements of the tW process at CMS

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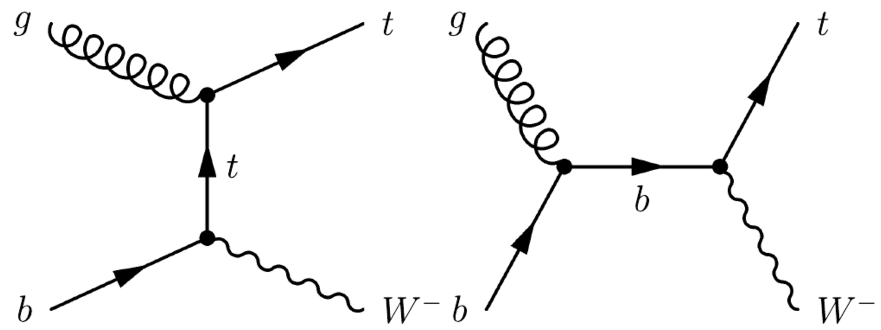
Introduction

- The CMS' latest measurement of single top differential cross sections has been done on the tW process with 2016 data using dilepton final states (CMS-PAS-TOP-19-003).



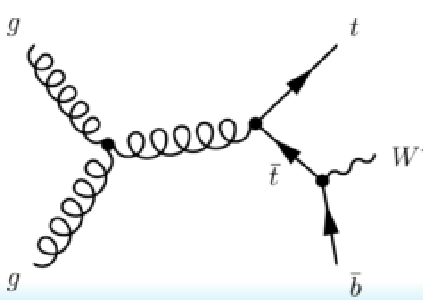
- Main challenge: **background** *largely* **dominates signal**, being the most important $t\bar{t}$.

- **Interference** between signal and ttbar processes **at NLO**. In order to resolve both processes' definitions, and avoid double counting issues, two approaches (JHEP 07 (2008) 029) are used to simulate tW events.

  - Diagram Removal (**DR**): we remove Feynman diagrams that might present two on-shell tops (also called *double resonant*).

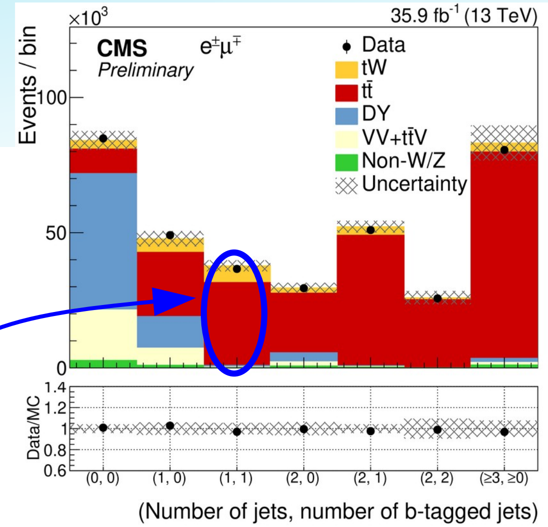
  - Diagram Subtraction (**DS**): we remove locally the pair-production contribution by adding an artificial term in the calculation.

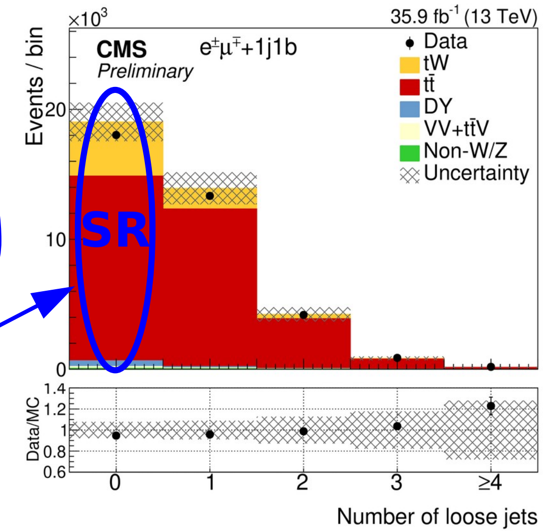
- The differential cross sections are measured as a function of the leading lepton p_T, jet p_T, $\Delta\varphi(e^{\pm},\mu^{\mp})$, $p_Z(e^{\pm},\mu^{\mp}, j)$, $m(e^{\pm},\mu^{\mp}, j)$ and $m_T(e^{\pm},\mu^{\mp}, j, p_T^{miss})$.



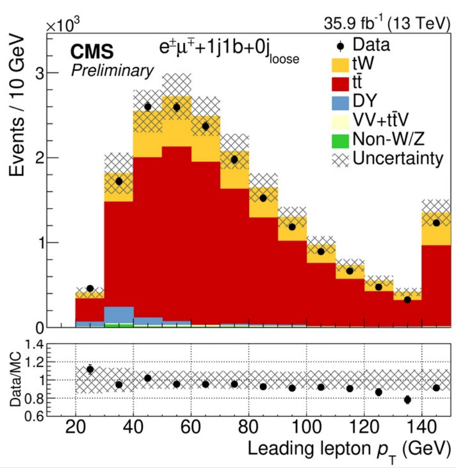
Methodology

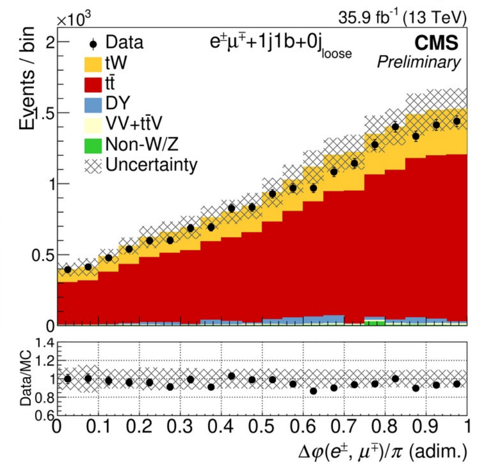
- The analysis is performed using the **complete 2016 dataset** (35.9 fb^{-1}).
- The **trigger strategy** uses a combination of single and double triggers to maximise efficiency.
- **Event selection**
  - At least two identified leptons.
  - One of them must fulfil p_T > 25 GeV, the other p_T > 20 GeV.
  - The two highest-p_T leptons must have opposite charge, be an electron and a muon (eμ channel), whose invariant mass satisfy m(e, μ) > 20 GeV.
  - Exactly one b-tagged jet (p_T > 30 GeV).
  - Veto on the presence of loose jets (20 GeV < p_T < 30 GeV).





- Signal is extracted by subtracting background from data.
- Unfolding (implemented using **`TUnfold`**: JINST 7 (2012) T10003) is done to an equivalent fiducial region at particle level. The result is normalised to the fiducial cross section.





Results and discussion

- **Agreement** between data and predictions (with the two generators, `POWHEG` and `MADGRAPH5_aMC@NLO`) is **fairly good**.

- Analysis **largely dominated by uncertainties associated with the ttbar background**.
  - Main sources: jet–related uncertainties (e.g. JES, JER) and modeling (e.g. ME/PS matching).
  - Depending on the bin and distribution, the effect of the uncertainties on the measured cross section varies from ~15-40% (bulk of distributions) up to ~25-100% in the tails.

- The result shows **compatible agreement** for the DR and DS schemes of the signal process.