The present work is a measurement of single top quark production cross sections and properties. The LHC is a top quark factory. The data set at \( \sqrt{s} = 8 \text{ TeV} \) provides possibility for high precision measurement of top quark decay products in the dilepton final state.

**Introduction**

The top quark is important for various SM tests and sensitive to new physics. The LHC is a top quark factory. The data set collected in 2012 with the center-of-mass energy \( \sqrt{s} = 8 \text{ TeV} \) provides possibility for high precision measurement of top quark production cross sections and properties.

The systematic uncertainties are determined separately for each bin by variation of efficiency correction factors, signal simulation with varied simulation parameters, jet-parton matching scale, \( Q^2 \)-scale, top quark mass. The main source of systematic uncertainties are the \( Q^2 \)-scale variation (typically 4%), JES variation (typically 3%) and matching (typically 3%).

**Event selection**

At least two opposite sign leptons
- \( p_T > 20 \text{ GeV/c} \)
- \(|n| < 2.4 \)
- \( m_T > 20 \text{ GeV/c} \)

At least two jets
- \( p_T > 30 \text{ GeV/c} \)
- \(|n| < 2.4 \)

At least one b-tagged jet
For the same flavour channels
- \( |m_T - m_t| > 15 \text{ GeV/c} \)
- \( E_{\text{miss}} > 40 \text{ GeV} \)

**Cross section determination**

The normalized differential cross section in bins of the variable \( X \) is defined as:

\[
\frac{1}{\Delta X} \frac{d\sigma}{dX} = \frac{1}{\mathcal{L}} \sum_i \left( N_i - N_i^b \right) A_i^{-1}
\]

\( A_i \) is the correlation matrix
\( \mathcal{L} \) is the luminosity

- **Migration corrections:**
  - Singeular Value Decomposition Unfolding (based on MadGraph+Pythia 6)
  - Correlation between bins: correlation matrix
  - Unfolding performed separately for each decay channel
  - Final result obtained from the statistical combination of all channels.

- **Differential cross sections in bins of top quark quantities are corrected to the full phase space:**
  - In bins of the lepton and b-jet variables measurement is done in the visible phase space:
    - For leptons: \( p_T > 20 \text{ GeV} \)
    - \(|n| < 2.4 \)
    - For b-jets: \( p_T > 30 \text{ GeV} \)
    - \(|n| < 2.4 \)

**Summary**

- The normalized differential \( t \bar{t} \) production cross sections were measured for the 2012 data set
- In general a good agreement with SM predictions is observed
- The \( t \bar{t} \) quark distributions agree the best with approx. NNLO
- Higher jet multiplicities prefer POWHES+Pythia 6

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**RESULTS**

The measurement of the normalized differential cross sections of \( t \bar{t} \) production is shown in bins of \( p_T(t), p_T(\text{leading } l), p_T(\text{lead } l), \) jet multiplicity, \( p_T(b_{\text{tagged}}) \) and \( m(t\bar{t}) \).

The 2012 data set was used. The systematic uncertainties are determined separately for each bin by variation of efficiency correction factors, signal simulation with varied simulation parameters, jet-parton matching scale, \( Q^2 \)-scale, top quark mass. The main source of systematic uncertainties are the \( Q^2 \)-scale variation (typically 4%), JES variation (typically 3%) and matching (typically 3%).