Differential cross section measurements of the tW process at CMS

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Introduction

The tW process is one of the main channels for single top quark production.

- At NLO shows interference with the pair production diagrams of top quarks.
- Allows to probe the $V_{tb}$ element of the CKM matrix.
- Is sensitive to beyond Standard Model physics.

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

Methodology

- Event selection:
  - Dileptonic channel ($e^\pm\mu^\mp$, with $p_T > 25, 20$ GeV).
  - $m(e^\pm\mu^\mp) > 20$ GeV.
  - Exactly one jet ($p_T > 30$ GeV) that is b-tagged. This exploits the $(n_{\text{jet}}, n_{\text{b-tagged jets}})$ distribution, as seen in the figure, to enhance signal-to-background ratio.
  - Veto events with loose jets ($p_T < 30$ GeV), as seen in the plot.

- Dominated by the overwhelming top quark pair production.

- Signal is extracted by subtracting the background from the data.

- Unfolding [1] is performed to take into account detector effects in the reconstruction.

- Systematic uncertainties are considered by repeating the entire process for each variation, and then taking the difference with the result.

- No regularisation was deemed necessary, as all response matrices are mostly diagonal.

Results

- Distributions are unfolded to particle level and normalised to the fiducial cross section.

- The main sources of uncertainty, both in the jet reconstruction and the theoretical modeling, are driven by the large top quark pair production background.

- The results obtained are, in general, consistent with the expectations from the two generators used for the modeling of the signal, POWHEG and MADGRAPH5_aMC@NLO.