Study of the underlying event and exclusive b decays in top-pair events

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INTRODUCTION
We present exploratory studies based on pp collisions recorded with the CMS detector in 2012 at $\sqrt{s} = 8$ TeV, with the aim to constrain systematic uncertainties related to the modelling of the underlying event in $t\bar{t}$ events and to pave the way for alternative top mass measurements.

UNDERLYING EVENT STUDIES

Underlying event:
Any hadronic activity not attributed to decay products of the $t\bar{t}$ system, including ISR/FSR, MPI, and beam remnants

We select a high purity dilepton sample and characterize the soft charged activity subtracting the estimated contribution from the hard process.

Data-to-simulation scale factors for the average $p_T$ of charged particles as function of $p_T(t\bar{t})$ for different soft-QCD generator models (left) or as function of the angle to the $t\bar{t}$ direction (right).

Event-by-event axis:
Using the $t\bar{t}$ system direction for each event:

\[ \vec{p}_T(t\bar{t}) = \vec{p}_T(b1) + \vec{p}_T(b2) + \vec{p}_T(\ell) + \vec{p}_T(\ell') + \vec{p}_\text{miss} T \]

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The invariant mass of the combination $J/\psi$+lepton is correlated to the top one and thus could be used for an alternative measurement.

Reconstruction of $J/\psi \rightarrow \mu^+\mu^-$ in leptonic $t\bar{t}$ events:
We select events with one/two isolated lepton(s), an opposite-sign dimuon pair whose invariant mass is around the $J/\psi$ one, and add a jet requirement. The observed kinematics are compared with MadGraph+Pythia6 and Pythia6 standalone simulations.

\[ \text{Reconstructed } m_{J/\psi} (GeV) \]

\[ \text{Data} = 354 \quad 60 \]

\[ \text{Expected statistical error} \]

\[ \text{Systematic uncertainties would be mainly attributed to b-fragmentation, and should not be impacted by jet-related sources.} \]

BIBLIOGRAPHY

Study of the underlying event, b-quark fragmentation and hadronization properties in top-pair events, CMS PAS TOP-13-007.

Determination of the top mass with exclusive events $t \rightarrow Wb \rightarrow \ell\nu J/\psi$, CMS NOTE 2006/058.