Table of Contents

Search for high-mass resonances decaying to tt in the lepton+jets channel..................................................1
Abstract........................................................................................................................................................1
Approved Plots ( click on plot to get .pdf )...............................................................................................1
Search for high-mass resonances decaying to $tt$ in the lepton+jets channel

Abstract

We perform a model-independent search for the production of heavy resonances with mass greater than 1 TeV decaying to top quark pairs. Using data samples corresponding to $5.0 \, \text{fb}^{-1}$ of integrated luminosity of pp collision data recorded with the CMS experiment in 2011 at $\sqrt{s} = 7 \, \text{TeV}$, we select events containing one lepton (electron or muon) and at least two jets and look for excesses above standard model background prediction in the top quark pair invariant mass spectrum. The high transverse momenta of the top quarks originating from such decays result in an event topology which requires a dedicated event selection and reconstruction of the invariant top quark pair mass. We use a 2 method in the reconstruction and selection of top quark pairs and apply $b$-tagging to improve sensitivity. In the absence of evidence for a signal, we evaluate 95% CL. upper limits on $(\sigma(pp \rightarrow Z' \rightarrow tt) \times \text{BR})$ as a function of the invariant mass of the resonance.

Approved Plots (click on plot to get .pdf)

<table>
<thead>
<tr>
<th>Figure</th>
<th>Abbreviated Caption</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Comparison between Data and simulated events for the $\chi^2$ variable in the electron+jets channel" /></td>
<td>Comparison between Data and simulated events for the $\chi^2$ variable in the electron+jets channel</td>
</tr>
<tr>
<td><img src="image2.png" alt="Comparison between Data and simulated events for the $\chi^2$ variable in the muon+jets channel" /></td>
<td>Comparison between Data and simulated events for the $\chi^2$ variable in the muon+jets channel</td>
</tr>
<tr>
<td><img src="image3.png" alt="Data/MC comparisons of Njet for electron+jets, 0 b-tag. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$." /></td>
<td>Data/MC comparisons of Njet for electron+jets, 0 b-tag. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$. M = 1 TeV/c^2 (M = 2 TeV/c^2 and M = 3 TeV/c^2) boson samples.</td>
</tr>
</tbody>
</table>
Data/MC comparisons of Njet for electron+jets, 1+ b-tag. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1 \text{ TeV/c}^2$ ($M = 2 \text{ TeV/c}^2$ and $M = 3 \text{ TeV/c}^2$) boson samples.

Data/MC comparisons of Njet for muon+jets, 0 b-tag. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1 \text{ TeV/c}^2$ ($M = 2 \text{ TeV/c}^2$ and $M = 3 \text{ TeV/c}^2$) boson samples.

Data/MC comparisons of Njet for muon+jets, 1+ b-tag. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1 \text{ TeV/c}^2$ ($M = 2 \text{ TeV/c}^2$ and $M = 3 \text{ TeV/c}^2$) boson samples.

Data/Background comparison for reconstructed distributions for the $tt$ invariant mass in the electron+jets channel in the zero b-tagged sample. The background yields are obtained from a maximum likelihood fit, as described in the text. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1 \text{ TeV/c}^2$ ($M = 2 \text{ TeV/c}^2$ and $M = 3 \text{ TeV/c}^2$) boson samples. The hatched bands in the plots correspond to yield changes when applying the following systematics: JES, JER, b-tagging uncertainties and pileup.

Data/Background comparison for reconstructed distributions for the $tt$ invariant mass in the electron+jets channel in the one or more b-tagged sample. The background yields are obtained from a maximum likelihood fit, as described in the text. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1 \text{ TeV/c}^2$ ($M = 2 \text{ TeV/c}^2$ and $M = 3 \text{ TeV/c}^2$) boson samples. The hatched bands in the plots correspond to yield changes when applying the following systematics: JES, JER, b-tagging uncertainties and pileup.
Data/Background comparison for reconstructed distributions for the $t\bar{t}$ invariant mass in the muon+jets channel in the zero b-tagged sample. The background yields are obtained from a maximum likelihood fit, as described in the text. A cross section of 1.0 pb (0.3 pb) is used for the normal- ization of the $Z'\ M = 1\ TeV/c^2$ ( $M = 2\ TeV/c^2$ and $M = 3\ TeV/c^2$ ) boson samples. The hatched bands in the plots correspond to yield changes when applying the following systematics: JES, JER, b-tagging uncertainties and pileup.

Data/Background comparison for reconstructed distributions for the $t\bar{t}$ invariant mass in the muon+jets channel in the one or more b-tagged sample. The background yields are obtained from a maximum likelihood fit, as described in the text. A cross section of 1.0 pb (0.3 pb) is used for the normal- ization of the $Z'\ M = 1\ TeV/c^2$ ( $M = 2\ TeV/c^2$ and $M = 3\ TeV/c^2$ ) boson samples. The hatched bands in the plots correspond to yield changes when applying the following systematics: JES, JER, b-tagging uncertainties and pileup.

Number of expected and observed events in 4.4 fb$^{-1}$ (5.0 fb$^{-1}$) in the electron channel (muon channel). The $Z'$ samples are normalized to 1 pb cross section. The total yield of the simulated samples are scaled with scale factors obtained by maximizing the binned likelihood function used in the statistical evaluation discussed in Sec. 8. The uncertainty in the total back- ground yields corresponds to yield changes when applying the following systematics: JES, JER, b-tagging uncertainties and pileup.

Data/Background comparison for reconstructed distributions for the $t\bar{t}$ invariant mass after rebinning the first and last bins. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'\ M = 1\ TeV/c^2$ ( $M = 2\ TeV/c^2$ and $M = 3\ TeV/c^2$ ) boson samples. The background yields are obtained from a maximum likelihood fit, as described in the text. The plots are shown in the electron channel, 0 b-tagged jets.

Data/Background comparison for reconstructed distributions for the $t\bar{t}$ invariant mass after rebinning the first and last bins. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'\ M = 1\ TeV/c^2$ ( $M = 2\ TeV/c^2$ and $M = 3\ TeV/c^2$ ) boson samples. The background yields are obtained from a maximum likelihood fit, as described in the text. The plots are shown in the electron channel, 1+ b-tagged jets.
Data/Background comparison for reconstructed distributions for the $tt$ invariant mass after rebinning the first and last bins. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1$ TeV/c$^2$ ($M = 2$ TeV/c$^2$ and $M = 3$ TeV/c$^2$) boson samples. The background yields are obtained from a maximum likelihood fit, as described in the text. The plots are shown in the muon channel, 0 b-tagged jets.

Data/Background comparison for reconstructed distributions for the $tt$ invariant mass after rebinning the first and last bins. A cross section of 1.0 pb (0.3 pb) is used for the normalization of the $Z'$ $M = 1$ TeV/c$^2$ ($M = 2$ TeV/c$^2$ and $M = 3$ TeV/c$^2$) boson samples. The background yields are obtained from a maximum likelihood fit, as described in the text. The plots are shown in the muon channel, 1+ b-tagged jets.

Expected and observed CLs 95% confidence level upper limits on $\sigma(pp \rightarrow Z' \rightarrow tt)$ for narrow $Z'$ resonances, as a function of the invariant mass of the resonance, in the combined electron+jets and muon+jets channels.

Expected and observed CLs 95% confidence level upper limits on $\sigma(pp \rightarrow Z' \rightarrow tt)$ for wide $Z'$ resonances, as a function of the invariant mass of the resonance, in the combined electron+jets and muon+jets channels.

Distribution of the reconstructed invariant top quark mass on the lepton side ($M_{lep}$) for the correct hypothesis in matchable events in mu+jets events.
Distribution of the reconstructed invariant top quark mass on the hadronic side (Mlep) for the correct hypothesis in matchable events in mu+jets events.

Comparison of expected limits between the narrow Z'(ttbar) analyses: dileptons (TOP-11-010), low mass lepton+jets analysis (TOP-11-009), high mass lepton+jets (EXO-11-093), and all-hadronic (EXO-11-006)

Comparison of expected limits between the wide Z'(ttbar) analyses: low mass lepton+jets analysis (TOP-11-009), high mass lepton+jets (EXO-11-093), and all-hadronic (EXO-11-006)

Event Display in the Muon+jets channel. This event is the one with the largest reconstructed Mttbar in the mu+jets channel. The chi2 value is 1.14. The event topology of high-mttbar events is visible: (i) the hadronic top quark candidate consists of only one jet, (ii) the muon is not far away from the jet and not well-isolated.
Event Display in the Electron+jets channel. The hadronic top consists of two jets; the event has two b-tagged jets.

-- SamvelKhalatian - 23-May-2012

This topic: CMSPublic > PhysicsResultsEXO11093
Topic revision: r14 - 2012-05-29 - SteveWorm