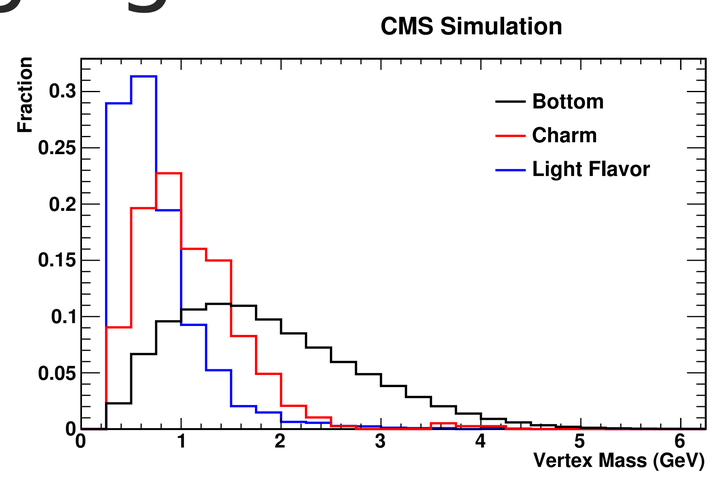
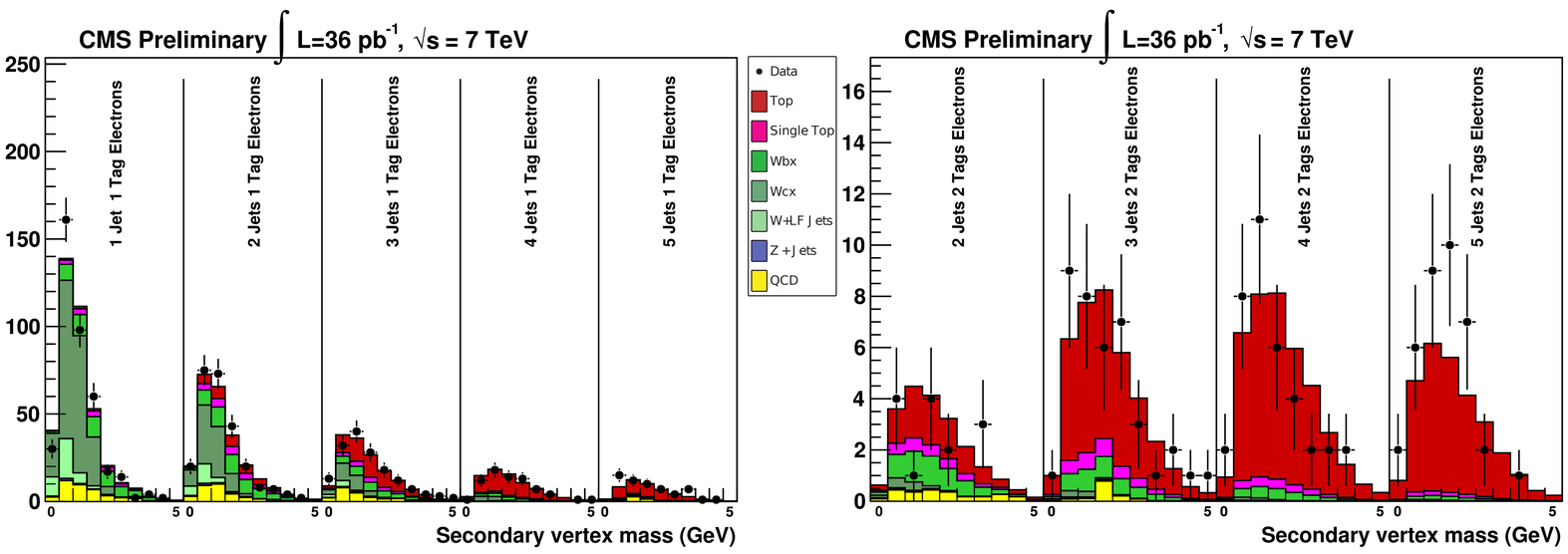
William P Martin on behalf of the CMS Collaboration

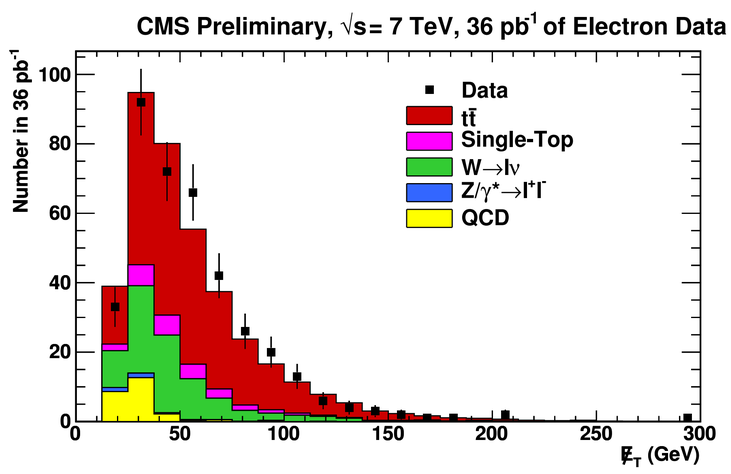
Measurement of the $t\bar{t}$ cross section at CMS with 36 pb^{-1} of data in the electron+jets channel with b-tagging

Semi-leptonic *b*-hadron decay results in the production of a lepton with a displaced origin that is embedded inside a jet. These characteristics can be used to identify *b*-quark jets and distinguish them from their non-*b* counterparts, helping to suppress the backgrounds from *W*(*Z*) and QCD multijet production. The latter is the dominant background of this analysis. Here, a displaced simple secondary vertex tagger is used, which implements the 3D signed decay length as the algorithm discriminant. The uncertainty in the *b*-tag efficiency is extracted directly from the fit, by using the changes in the relative rates of 1-tag and 2-tag events.



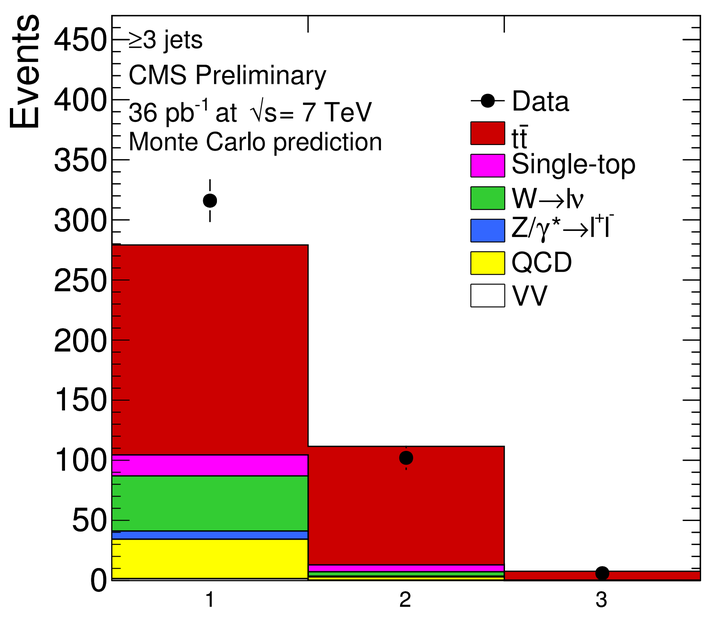
Secondary vertex mass distribution for bottom, charm, and light flavor jets.





Kinematic distribution of the missing transverse energy.

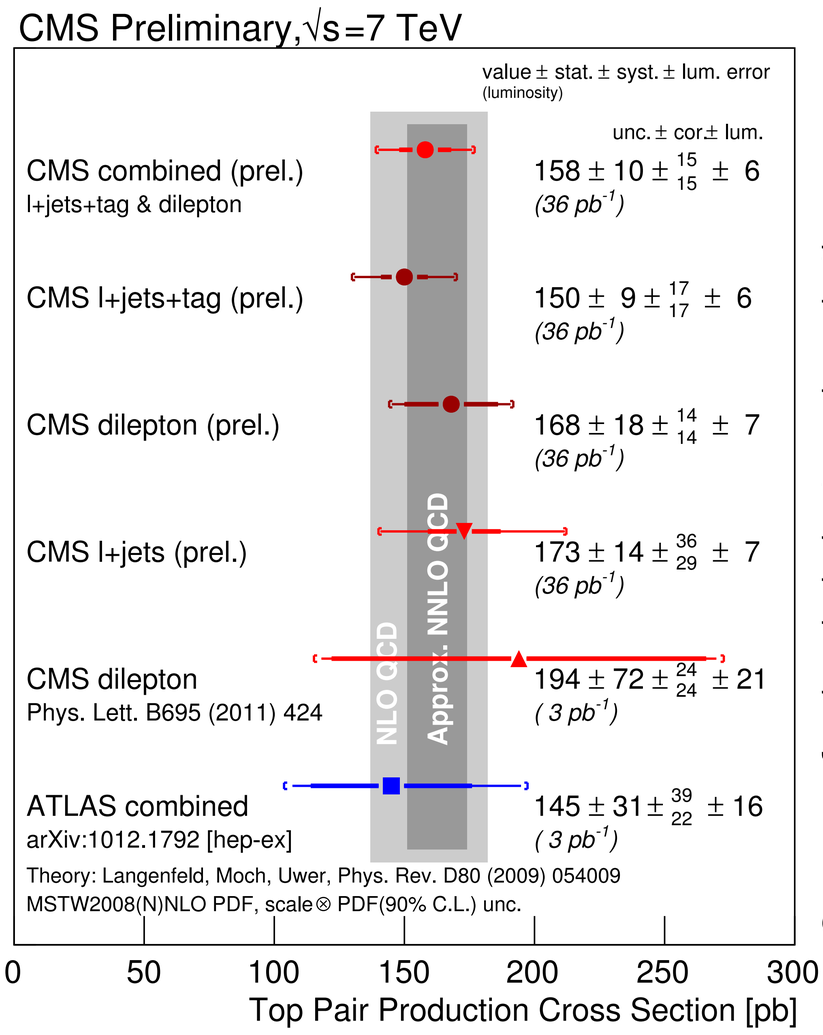
The $t\bar{t}$ cross section is calculated by performing a simultaneous fit to the secondary vertex mass (SVM) distribution in the data [1], using the sum of the signal & background templates and a binned Poisson likelihood. The SVM is fitted in a 2D grid of jet-multiplicity and tag-multiplicity. The templates for the fit are normalized to the expected event yields for this integrated luminosity. The yields are a function of the jet energy scale (JES), the *b*-tagging efficiency, and the background normalization. The JES and the Q^2-scales impact the jet multiplicity, and the *b*-tagging efficiency impacts the number of *b*-tags.



Comparison of observed and predicted b-tag multiplicities for ≥ 3 jet events.

A simple counting analysis using the same vertex tagger was used as a cross-check. QCD background estimation was performed using a fit to the electron relative isolation distribution & the background due to *W*+jets was estimated using Berends scaling to measure the jet multiplicity distribution before *b*-tagging. These backgrounds are subtracted from the data, along with smaller contributions from Single-top, Drell-Yan and Di-Boson production, to produce the $t\bar{t}$ event yield. The resulting cross section was found to be in good agreement with the reference analysis.

The affect of *b*-tagging on the cross section measurement can be seen in the following summary plot:



Summary of various inclusive top pair production cross section measurements made in 7 TeV proton-proton collisions [2].

List of systematic uncertainties for electron fit.

The fitted $t\bar{t}$ cross section for the electron+jets channel:

$$\sigma_{t\bar{t}} = 158 \pm 14\,(\text{stat.}) \pm 19\,(\text{syst.}) \pm 6\,(\text{lumi.})\ \text{pb}$$

The cross section extraction method was also applied to the muon+jets channel. The combined fitted $t\bar{t}$ cross section was calculated as:

$$\sigma_{t\bar{t}} = 150 \pm 9\,(\text{stat.}) \pm 17\,(\text{syst.}) \pm 6\,(\text{lumi.})\ \text{pb}$$

[1] The CMS Collaboration "Measurement of the $t\bar{t}$ Pair Production Cross Section at √s = 7 TeV using *b*-quark Jet Identification Techniques in Lepton + Jet Events" **CMS TOP-10-003**
[2] The CMS Collaboration "Combination of top pair production cross sections in *pp* collisions at √s = 7 TeV and comparisons with theory" **CMS PAS TOP-11-001**

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