Measurement of Differential $t\bar{t}$ Cross Section with Boosted Tops at 8 TeV using CMS data

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on behalf of CMS collaboration

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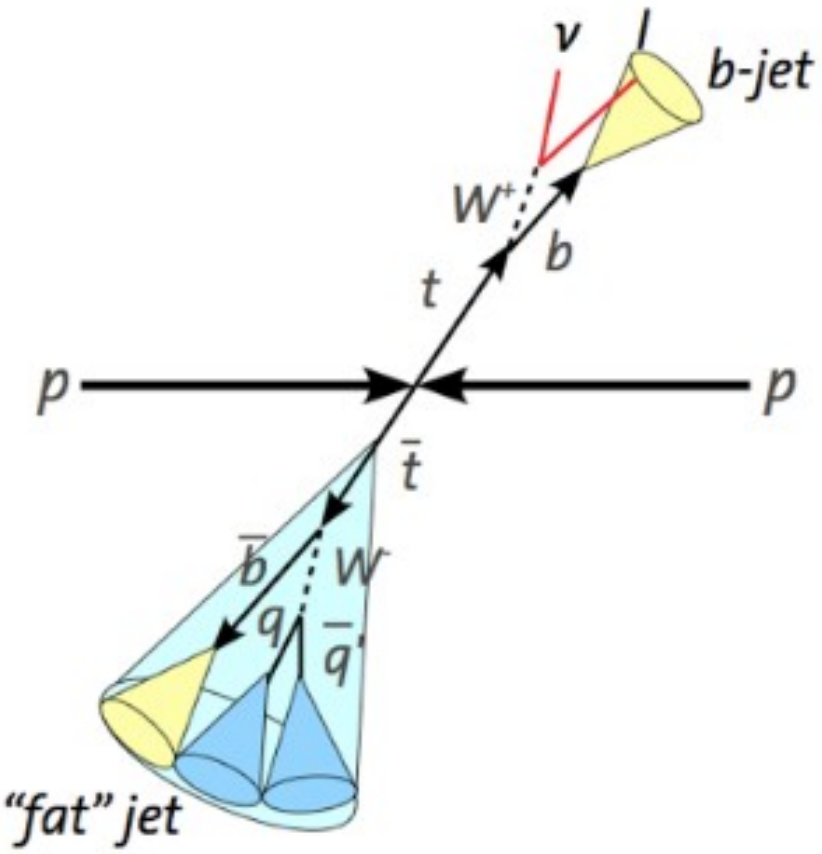
Introduction

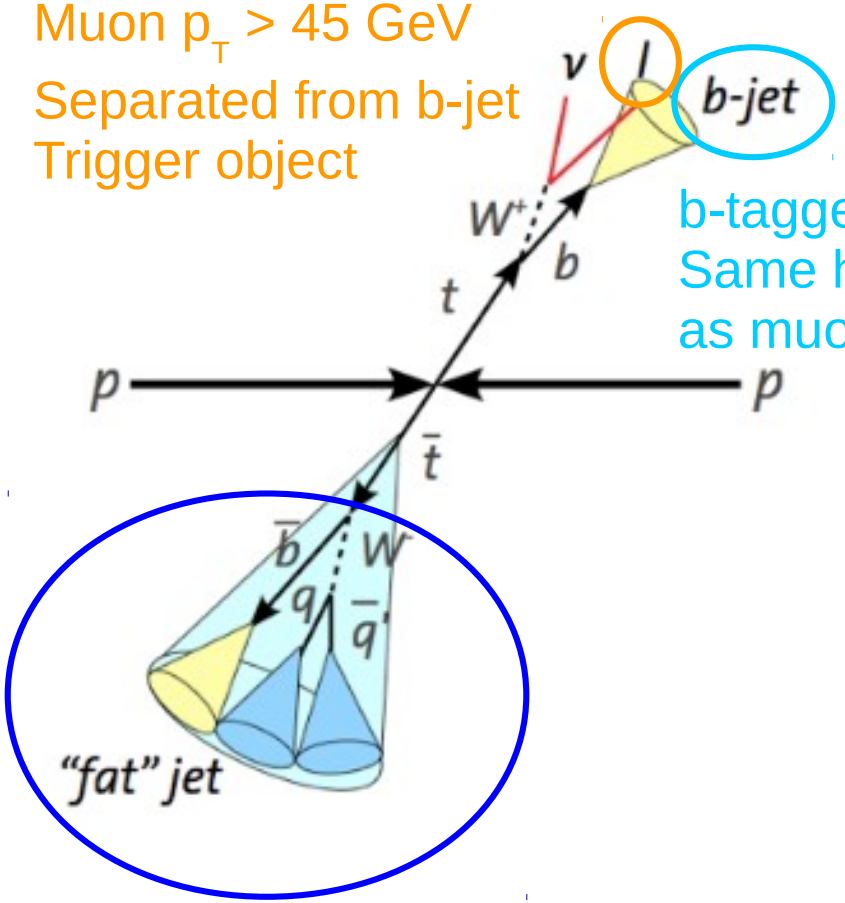
- Measuring $t\bar{t}$ cross section in bins of p_T(top) for high-p_T (boosted) tops
  - First measurement at CMS
    - ATLAS boosted result shown at TOP 2014
  - More relevant in Run II
  - Important background
  - Improve MC modeling



Final State: semileptonic, muon channel

Selection

Muon p_T > 45 GeV
Separated from b-jet
Trigger object



b-tagged jet
Same hemisphere as muon

Top-tagged jet
p_T(top) > 400 GeV
Opposite hemisphere from muon

Backgrounds

- Non-signal $t\bar{t}$ (POWHEG)
- Single top (POWHEG)
- W+jets (MadGraph)
- QCD (data-driven)
- Final event counts will be extracted from signal + background template fit in several kinematic regions

Predicted # Events, pre-fit

CMS Work in Progress

Sample	# Events
$t\bar{t}$ signal	353 ± 6
$t\bar{t}$ other	37.3 ± 2.0
Single top	4.0 ± 1.3
W+Jets	4.4 ± 1.3
QCD	$9.9^{+14.6}_{-9.9}$
Total	**408^{+16}_{-12}**
Data	**340**

w/ Stat. Unc.

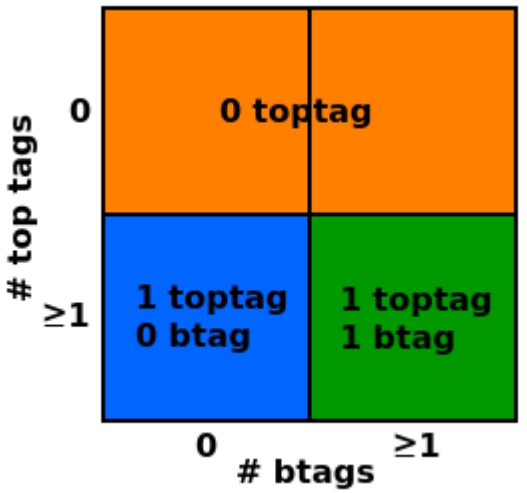
~16% background in signal region

20% MC excess over data

Signal + Background Fit

- Template fit in several exclusive regions
- Extracting
  - Signal and background normalizations
  - Top-tagging efficiency

Fit Regions

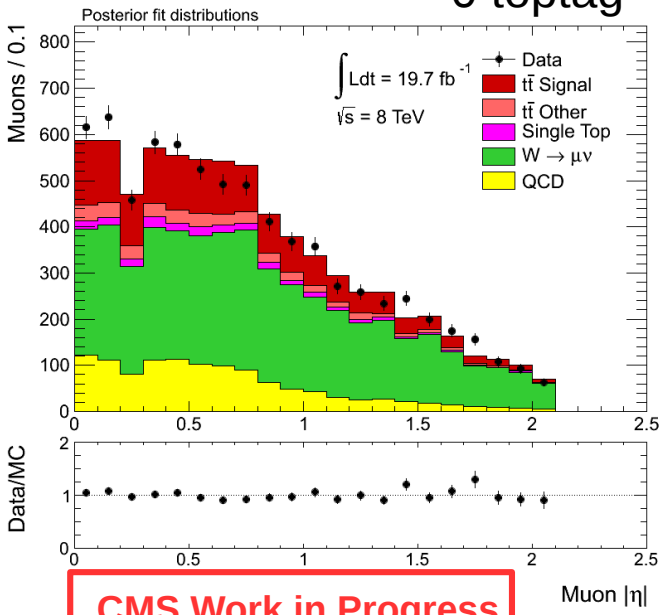


Fit Results

CMS Work in Progress

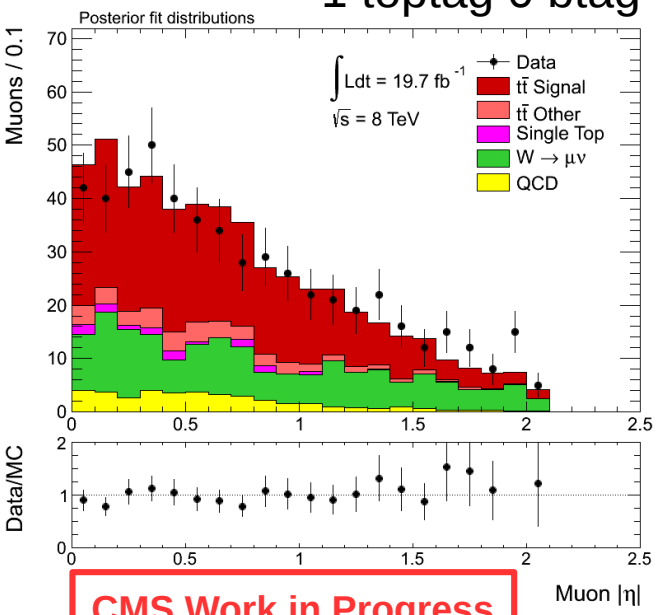
	1 toptag 1 btag
$t\bar{t}$ Signal	291 ± 41
$t\bar{t}$ Other	30.8 ± 4.3
Single top	3.7 ± 2.4
W+Jets	4.2 ± 0.7
QCD	9.5 ± 2.9
Total	340
Data	340

0 toptag



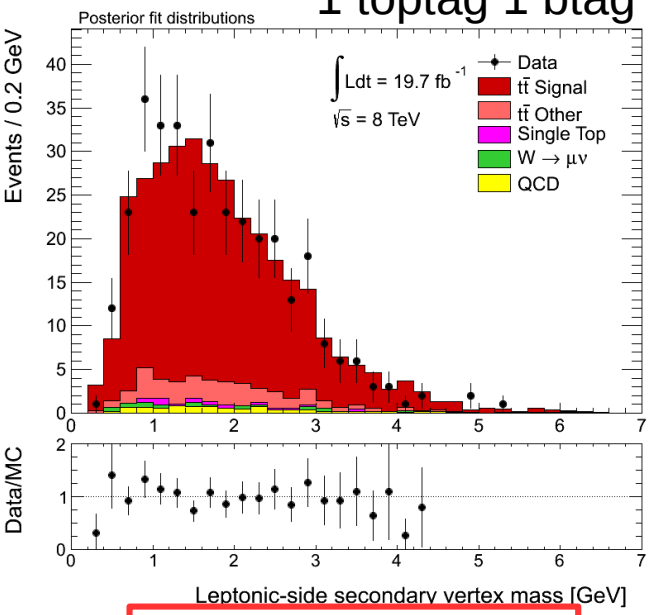
CMS Work in Progress

1 toptag 0 btag



CMS Work in Progress

1 toptag 1 btag

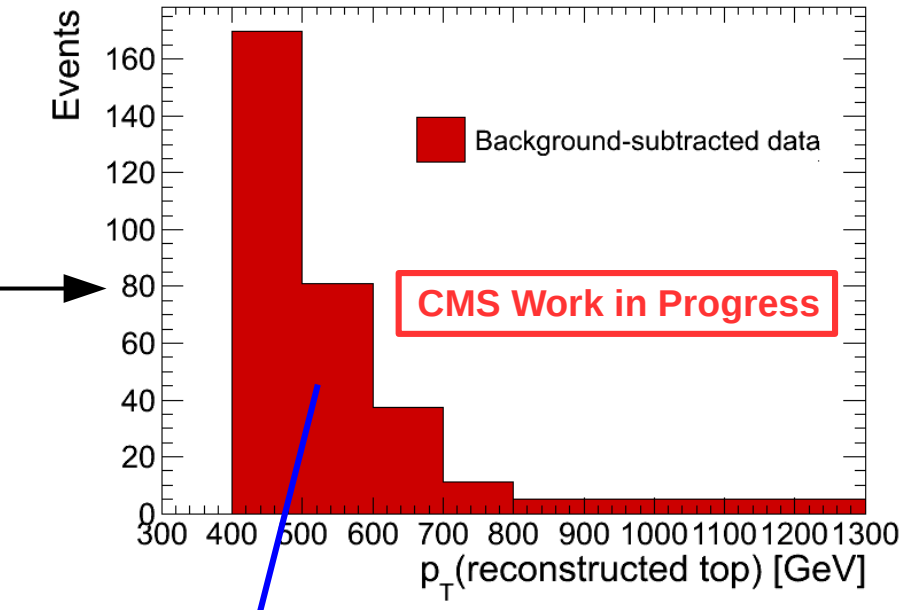


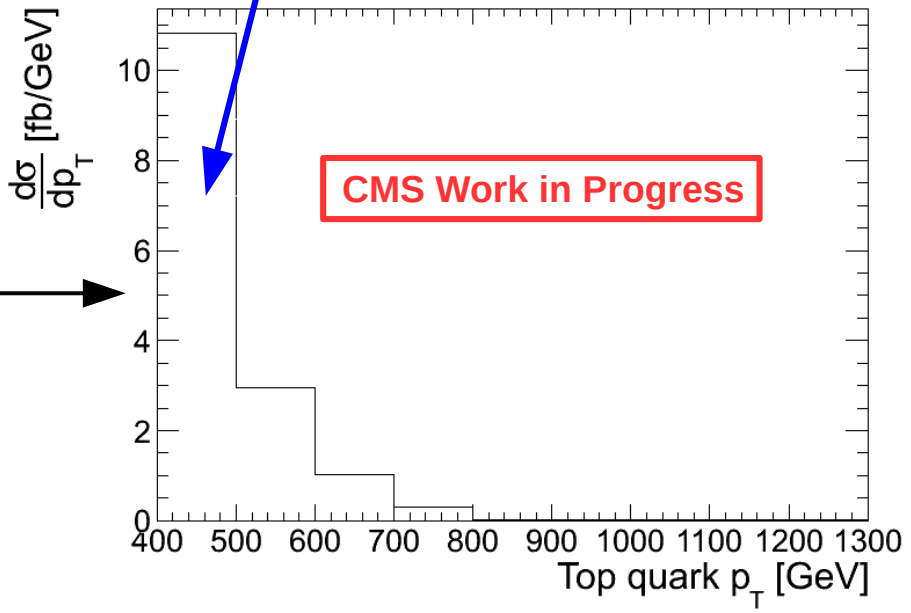
CMS Work in Progress

Extracting Differential Cross Section

- Extract # measured $t\bar{t}$ events in bins of p_T(top)
  - Subtract backgrounds from data distribution
- Correct for
  - Bin migrations
  - Acceptance / efficiency
- Calculate cross section in bins of p_T from unfolded p_T(top) distribution

"unfolding"





Summary & Conclusion

- Measured $t\bar{t}$ cross section in bins of of p_T(top) for p_T(top) > 400 GeV
  - Semileptonic final state, muon channel
  - First measurement for CMS
- Also extract integrated cross section for p_T(top) > 400 GeV
  - $\sigma_{Meas} = 194 \pm 27$ fb
  - $\sigma_{Meas} / \sigma_{Theory} = 0.83$
- Analysis (including measurement uncertainty) currently being finalized

Backup

Top-tagging

- Decay products of a highly-boosted top will be merged into a single 'top jet'
- Use 'CMS' top-tagging algorithm to identify top jets
  - Look for underlying structure (subjets)
  - Require
    - ≥ 3 subjets (b, q, q top decay products)
    - 140 GeV < jet mass < 250 GeV
    - Subjet minimum pairwise mass > 50 GeV
  - Algorithm 'turns on' at p_T(top) ~ 400 GeV
  - Algorithm 13-25% efficient, depending on top jet |η|

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