

Motivation

HEPTopTagger

Performance

Single top production

Summary

Top Tagging

work with Tilman Plehn, Michihisa Takeuchi, Michael Spannowsky

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Top quark

- copiously produced via strong interaction at LHC
 $\sigma_{tt}^{14\text{TeV}} = 918 \text{ pb}$, $\sigma_{tt}^{7\text{TeV}} = 165 \text{ pb}$, $\sigma_{tt}^{\text{Tevatron}} = 7.5 \text{ pb}$
- window to new physics: top partners, A_{FB}^t , σ_t/σ_s for single top
- strongly coupled to Higgs sector

Top tagger

- idea: reconstruct tops like bottoms at Tevatron
- several top taggers available
[John Hopkins Tagger, Thaler-Wang Tagger, N-Subjettiness Tagger, etc.]
- low p_T critical
 $\sigma_{tt}^{14\text{TeV}}(p_T > 500) \sim 100 \text{ fb}$, $\sigma_{tt}^{14\text{TeV}}(p_T > 200) \sim 9000 \text{ fb}$

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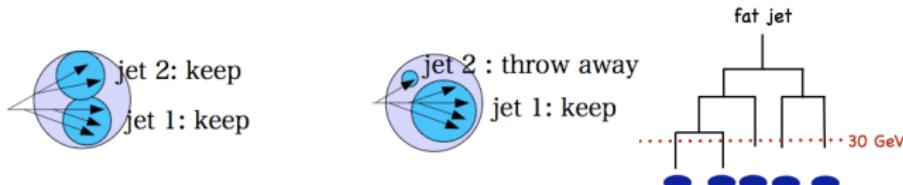
Single top production

Summary

1. fat jets – Cambridge-Aachen ($R = 1.5$), $p_T^{\text{fatjet}} > 200 \text{ GeV}$

2. mass drop criterion

- find hard sub-jets $m_j < 30 \text{ GeV}$, $m_{j1} < 0.8m_j$ to keep j_1 and j_2

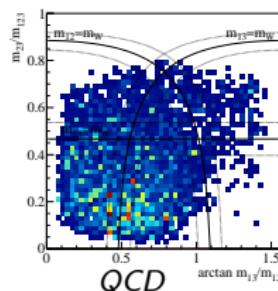
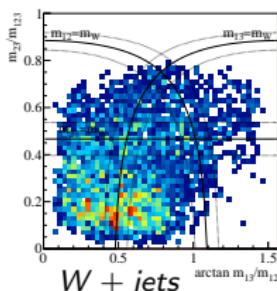
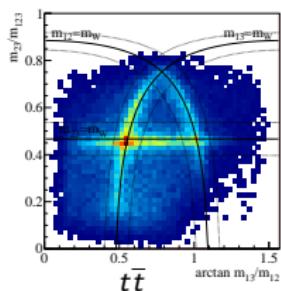


3. choose 3 hard sub-jets with best filtered mass [Phys. Rev. Lett. 100, 242001 (2008).]

- $|m_{jjj}^{\text{filt}} - m_t| < 25 \text{ GeV}$ and $p_T^{\text{rec}} > 200 \text{ GeV} \rightarrow \text{top candidate}$

4. check mass ratios

- W mass condition, soft-collinear cut \rightarrow tagged top



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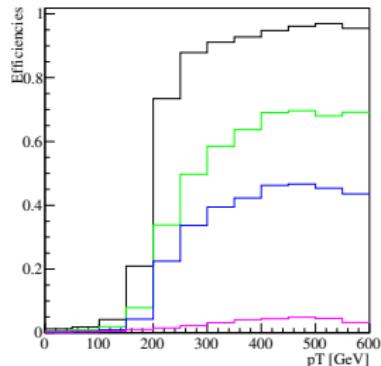
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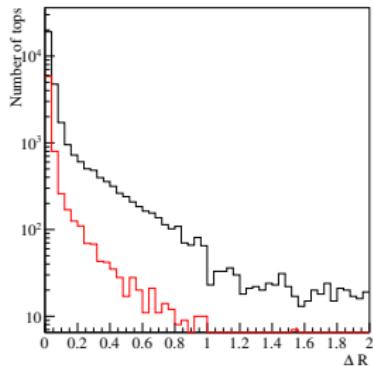
efficiency

- tagging rate: $\sim 35\%$ for hadronic tops
 - mis-tag rate: $W+jets: 4\%$, QCD: 2%
 - validation by ATLAS Heidelberg
- [Sebastian Schätzl, Gregor Kasieczka (talk at DPG)]



momentum reconstruction

- momentum well reconstructed
- better reconstruction for large p_T
 - black: $p_T^{\text{rec}} > 200\text{GeV}$
 - red: $p_T^{\text{rec}} > 300\text{GeV}$
- 95 % in $\Delta R < 0.5$



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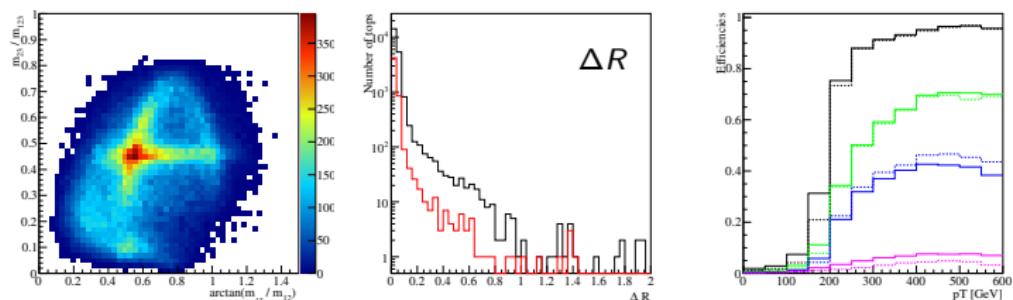
Summary

fast detector simulation: Delphes

- detector geometry
- momentum smearing
- isolated lepton identification

performance study for $t\bar{t}$

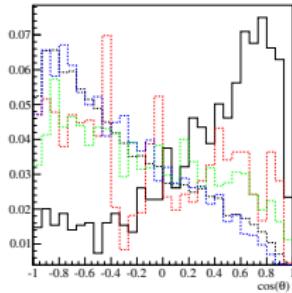
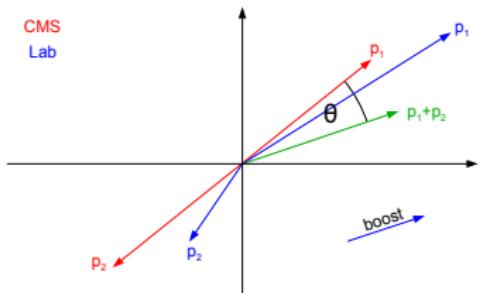
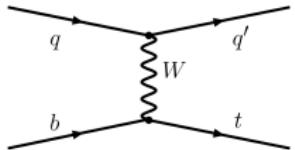
- topology of mass plane unchanged
- after Delphes: tagged tops with same kinematics as before
- tagging efficiency: 35%



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selection cuts for t-channel single top production

- b-tag inside tagged top
- pruning + filtering
- angular correlation between tagged top and recoil jet
[Collins-Soper angle, arXiv:0906.1803]
- kinematic cuts on recoil jet and top



- preliminary results at 8 TeV:

	$t\bar{t}$ -BG	QCD-BG	Single top	S/B
hadronic events $\sigma [fb]$	$98 \cdot 10^3$	$652 \cdot 10^6$	$46 \cdot 10^3$	0.00007
tagged top $\sigma [fb]$	$4.9 \cdot 10^3$	$209 \cdot 10^3$	$0.27 \cdot 10^3$	0.001
b-tag $\sigma [fb]$	$1.6 \cdot 10^3$	$4.1 \cdot 10^3$	$0.1 \cdot 10^3$	0.017
pruning $\sigma [fb]$	$1.1 \cdot 10^3$	$1.5 \cdot 10^3$	$0.08 \cdot 10^3$	0.028
$\cos \theta [fb]$	$0.13 \cdot 10^3$	$0.22 \cdot 10^3$	$0.04 \cdot 10^3$	0.097

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HEPTopTagger

- focus on moderate p_T tops ($p_T > 200\text{GeV}$), testable in SM
- hadronic top reconstruction well understood
- performance stays unchanged under detector simulation

analysis on single top in progress

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