

Classification of the $t\bar{t} + jets$ events in Monte Carlo simulations

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Agenda

1 Introduction

- Physical process
- Analysis setup

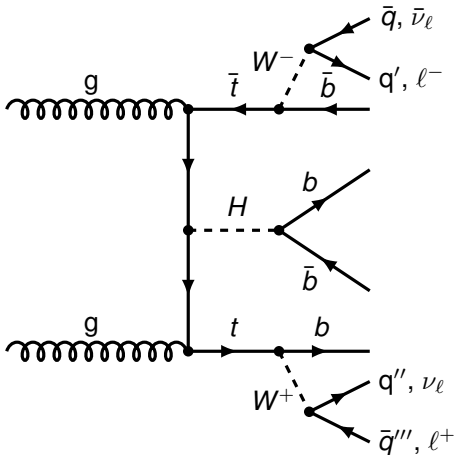
2 Comparison HFC & JTF

3 Modifications to the HFC

- General dependence
- Influence on comparison between HFC and JTF

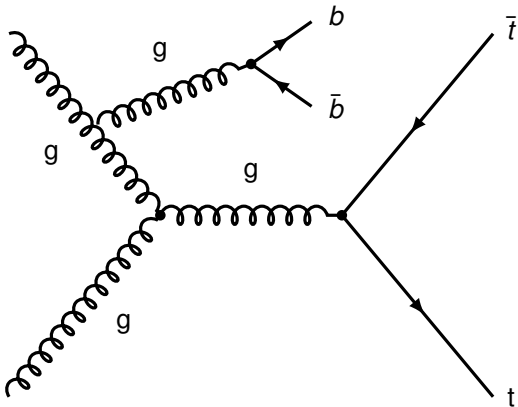
Introduction

Signal



- $t\bar{t} + H$
- 1% of total Higgs productions
- 58% chance of $H \rightarrow b\bar{b}$
- 4 b-jets + leptons and other jets

Background



- classify different types of $+jets$ background
- number of heavy flavour jets (bottom, charm)
- ⇒ further background selection

Cuts & Selections

Heavy Flavour Classification (HFC)

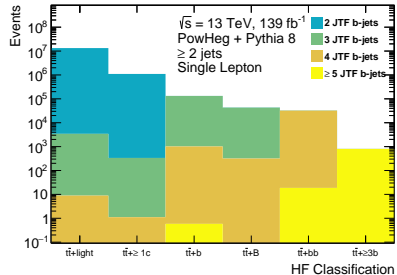
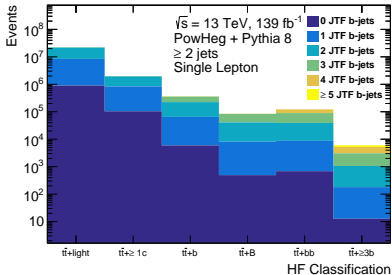
- truth level
 - event classification based on truth information
 - $p_T > 5 \text{ GeV}$ (leading) b - or c -hadron matched to jet with $\Delta R < 0.3$ of jet axis not coming from top decay
 - $p_T > 15 \text{ GeV}$ jet
- ⇒ categories $t\bar{t} + \text{light}$,
 $t\bar{t} + \geq 1c$, $t\bar{t} + b$, $t\bar{t} + B$,
 $t\bar{t} + bb$, $t\bar{t} + \geq 3b$

jet_truthflav (JTF)

- reconstruction level
 - flavour tagging of individual jets based on truth flavour
 - $p_T > 5 \text{ GeV}$ weakly decaying hadron matched to jet with $\Delta R < 0.4$ of jet axis (flavour hadron = flavour jet)
 - $p_T > 25 \text{ GeV}$ jet
- ⇒ events can contain any number of jets, each one with an assigned flavour (e.g. b , c)

Comparison HFC & JTF

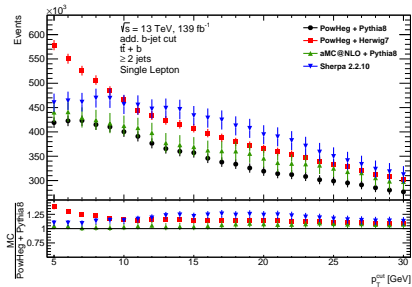
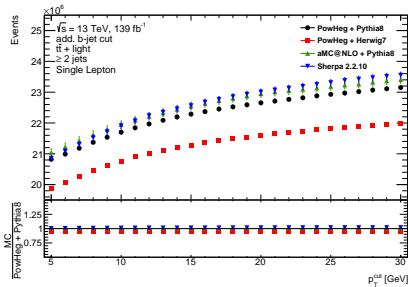
Comparison of HFC & JTF



- Does already work well
little overshoot, i.e. more JTF b -jets than expected from HFC
- Large number of events with less b -jets than expected
- $t\bar{t} + b$ and $t\bar{t} + B$ have most overshoot

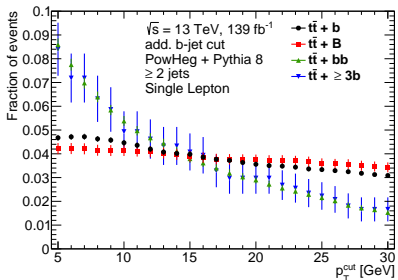
Modifications to the HFC

Influence of jet p_T cut



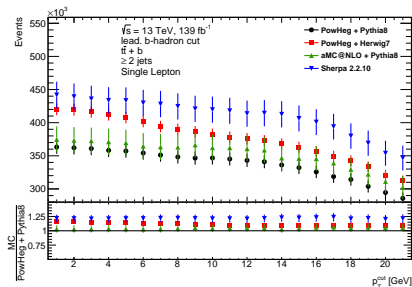
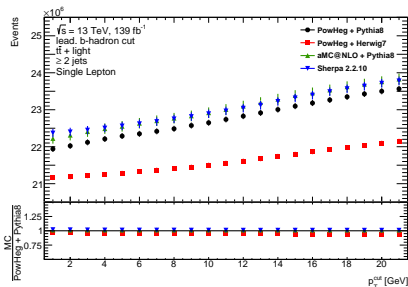
- increasing cut \iff increase in $t\bar{t} + \text{light}$ events
- increasing cut \iff decrease in $t\bar{t} + b$ events
- POWHEG + HERWIG7 sample deviates most, esp. at low energy

Influence of jet p_T cut



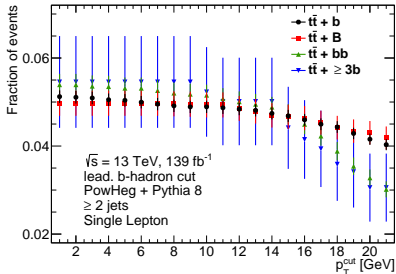
- all $t\bar{t} + \geq 1b$ subcategories behave similar
- $t\bar{t} + bb$ and $t\bar{t} + \geq 3b$ more sensitive

Influence of leading hadron p_T cut



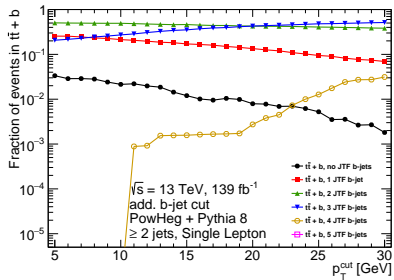
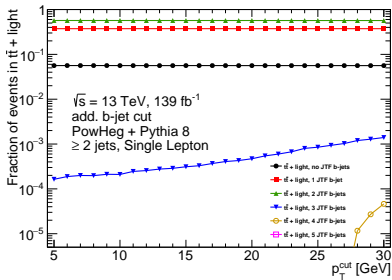
- behaviour similar to jet p_T cut
- less pronounced
- change in slope at $\approx 14 \text{ GeV}$
- SHERPA2.2.10 shows largest differences to nominal sample in $t\bar{t} + b$

Influence of leading hadron p_T cut



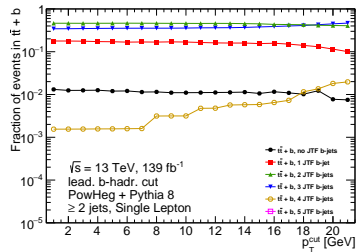
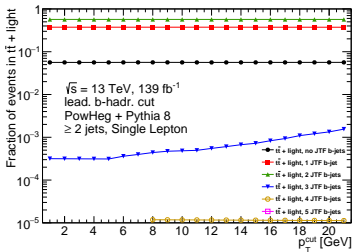
- $t\bar{t} + \geq 1b$ subcategories behave similarly up to 14 GeV
- above 14 GeV steeper slopes for higher add. b -jet multiplicities
- influence of 15 GeV jet cut?

Influence of jet p_T cut on HFC and JTF



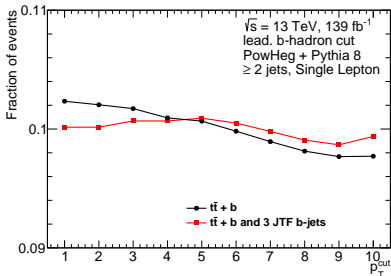
- increased cut \rightarrow fraction of events classified as expected increases
- increased cut \rightarrow more overshoot
- true for $t\bar{t} + \text{light}$ and $t\bar{t} + b$ (more pronounced for the latter)

Influence of leading hadron p_T cut on HFC and JTF



- behaviour similar to before
- less influence, larger changes only above 14 GeV

Influence of leading hadron p_T cut on HFC and JTF



- small maximum at the cut value of JTF hadron cut
- assimilation of cuts
→ assimilation of event classification?

Conclusions

- HFC is already working very well
- influence of generators is low (except at very low p_T cuts)
- a higher cut generally increases the number of $t\bar{t} + \text{light}$ events and reduces the number of $t\bar{t} + \geq 1b$ events
- a higher cut generally increases the fraction of events that are in accordance with JTF
- the two algorithms can be assimilated by similar cut values