Study of the interference effects in processes involving the *tZq* vertex at the Large Hadron Collider

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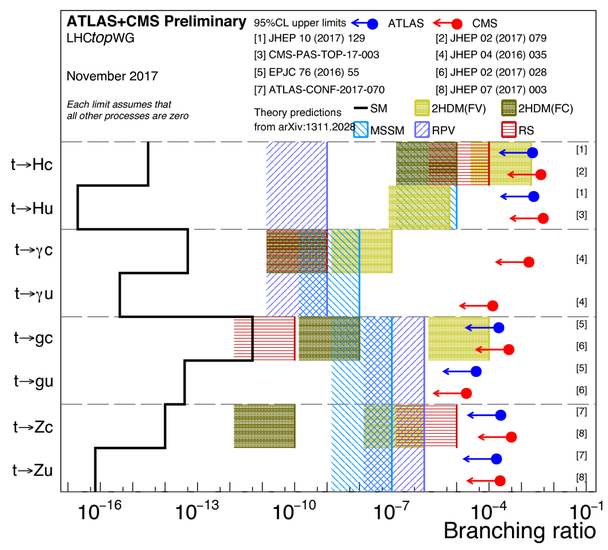
The top quark is the heaviest known fundamental particle, thus deserving a special attention in many extensions of the Standard Model (SM). The interactions of the top quark via Flavour Changing Neutral Currents (FCNC) are extraordinarily suppressed in the SM but can be significantly enhanced in models going beyond it. The current searches at the LHC consider the tZq (where q can be the u or c-quark) vertex where production or decay of top/anti top pairs via FCNC are studied without taking into account the interference between these processes. The aim of the current study is to access the importance of such interference effects.

Current limits

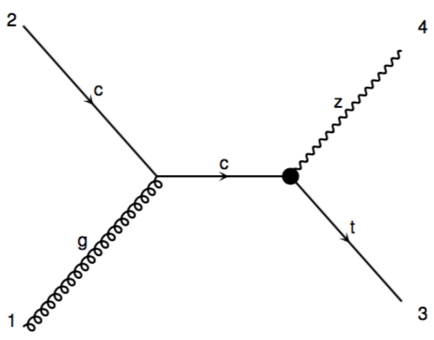


Branching ratios (BR) of the top quark decays via FCNC to a quark and a Z boson greater than 0.02% are excluded at 95% confidence level.

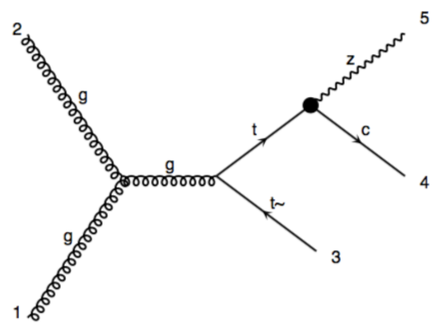
tZq vertex at the LHC

Simulated pp events with the tZq vertex were obtained with MADGRAPH5_AMC@NLO. In the production final state, there is a Z boson, a t quark or a $\bar{t}$ antiquark and a c quark or a $\bar{c}$ antiquark. The decay channel is similar but the t quark decays to a W^+ boson and a b quark and the $\bar{t}$ antiquark to a W^- boson and a $\bar{b}$ antiquark.

- generate $pp \rightarrow t\ Z$
  add process $pp \rightarrow \bar{t}\ Z$
- 4 processes with **8** Feynman diagrams



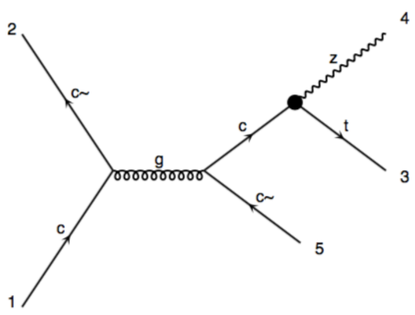
- generate $pp \rightarrow t\ \bar{t} \rightarrow Z\ \bar{c}$
  add process $pp \rightarrow t\ \bar{t} \rightarrow Z\ c$
- 2 processes with **18** Feynman diagrams



How can we have interference ?

With an extra light quark in the tZ production channel, interference with the $t\bar{t}$ channel becomes possible.

- generate $pp \rightarrow t\ Z\ \bar{c}$
  add process $pp \rightarrow \bar{t}\ Z\ c$
- **32** independent Feynman diagrams



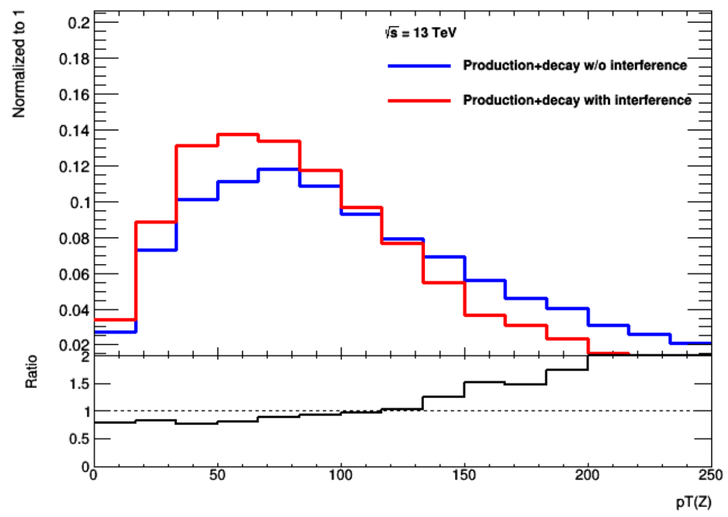
Monte Carlo generation

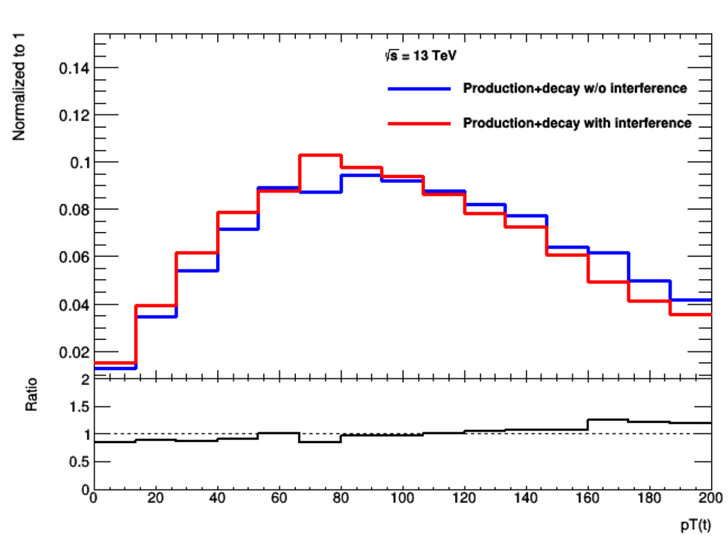
MADGRAPH5_AMC@NLO was used together with the TOPFCNC UFO model at Leading Order, but adding an extra light in the tZ production via FCNC.

- **Version:** 2.6.1
- **Shower and hadronization:** Pythia8
- **Detector simulation:** Delphes (under way)
- **Analysis:** MadAnalysis
- **UFO Model:** TOPFCNC UFO model considering only the tZq FCNC vertex. Couplings chosen to match the current BR limit of 2.2×10^{-4}
- **10000** events per process
- All samples generated with **MadSpin and Pythia8**

Preliminary distributions

A preliminary study at truth level was done in order to access the impact of considering interference or not when adding production and decay.





References:

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2. **Degrande C., Maltoni F., Wang J. and Zhang C.**, *Automatic computations at next-to-leading order in QCD for top-quark flavor-changing neutral processes*, Physical Review D, 91(3) (2015)
3. **Durieux G., Maltoni F. and Zhang C**, *Global approach to top-quark flavor-changing interactions*, Physical Review D, 91(7) (2015)

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