

## Rare decays at CMS

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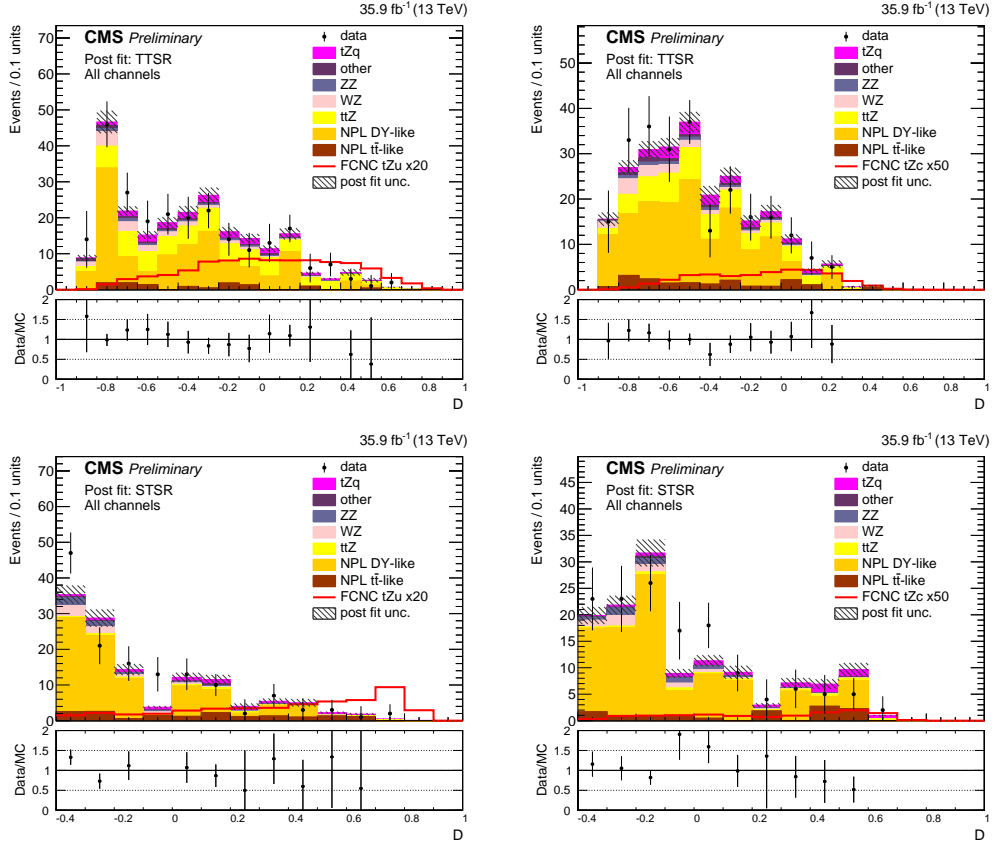
<sup>†</sup>On behalf of the CMS Collaboration.

## 1. Introduction

To be filled.

## 2. FCNC in $tZq \rightarrow 3\ell$

The source is [1]. As can be seen in Figure 1. As can be seen in Figure 2.



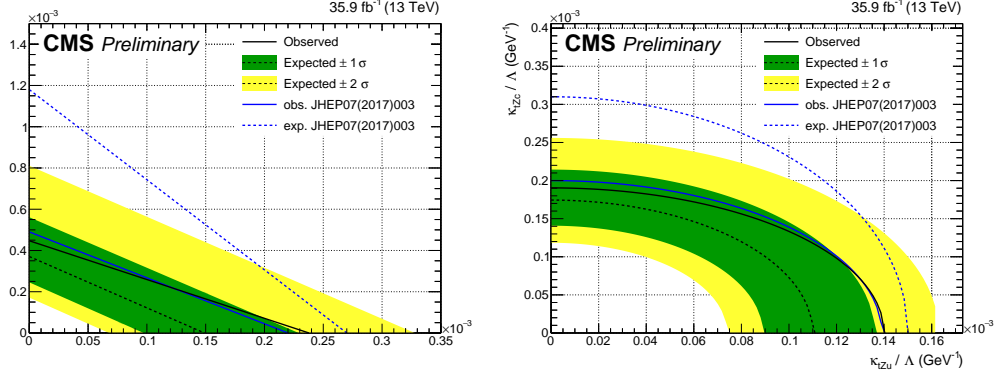
**Figure 1:** The discriminating variable distribution after the fit for all different leptonic channels. Upper left: top quark pair  $tZu$ ; upper right: top quark pair  $tZc$ ; lower left: single top quark  $tZu$ ; lower right: single top quark  $tZc$ .

## 3. FCNC in $tH \rightarrow b\bar{b}$

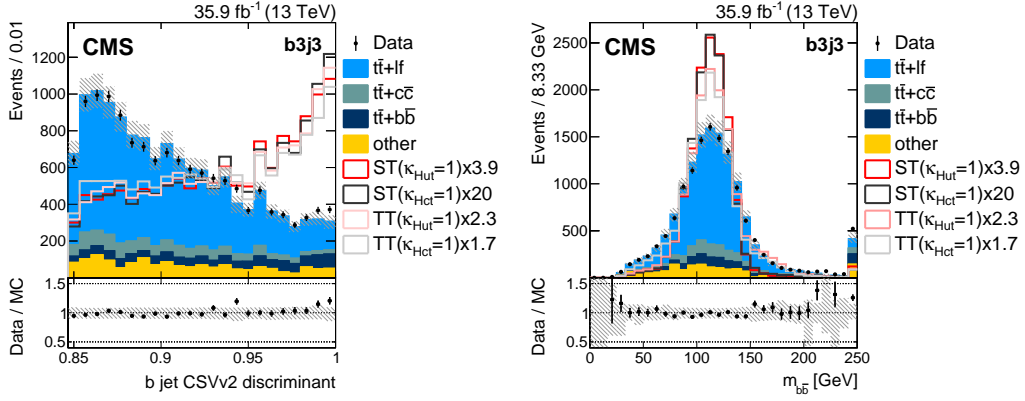
[2] 3 4 5

## 4. Angular observables in $B^+ \rightarrow K^+ \mu^+ \mu^-$

[3] 6 7 (top distributions).



**Figure 2:** Exclusion regions at 95% CL on the FCNC branching fractions (left) and couplings (right) in the 2D plane of both the  $tZu$  and  $tZc$  variables. The CMS 8 TeV observed (expected) limit is given with a blue line (dashed line).



**Figure 3:** Comparison between data and simulation for some of the most discriminating BDT input variables in the category with three jets, all of them b-tagged: CSV discriminant value for one of the reconstructed b jets assigned to Higgs boson decay (left), and reconstructed invariant mass of two b jets associated with the Higgs boson decay (right).

## 5. Angular observables in $B^0 \rightarrow K^{*0} \mu^+ \mu^-$

[6]

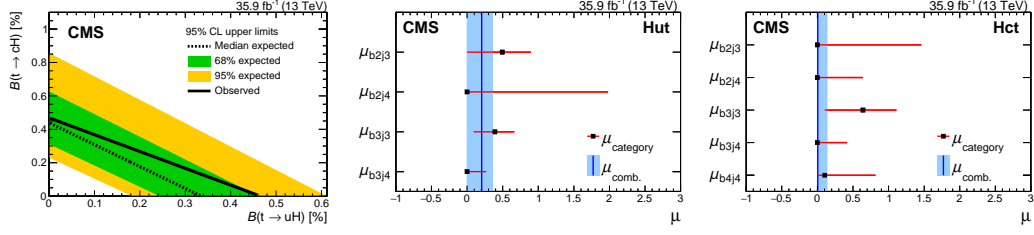
7 (bottom distributions).

## 6. Conclusions

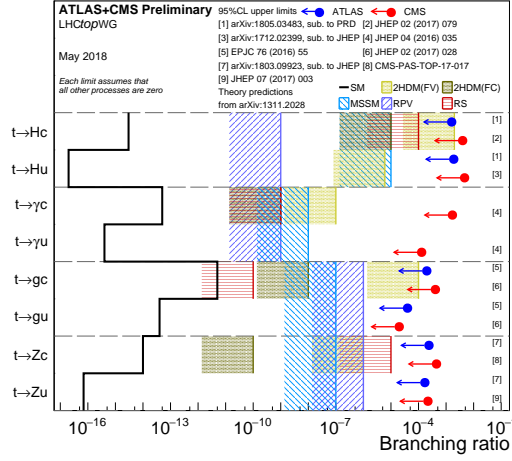
To be filled.

## References

- [1] CMS Collaboration, *Search for flavour changing neutral currents in top quark production and decays with three-lepton final state using the data collected at  $\sqrt{s} = 13$  TeV*, <https://cds.cern.ch/record/2292045>, CMS-PAS-TOP-17-017.

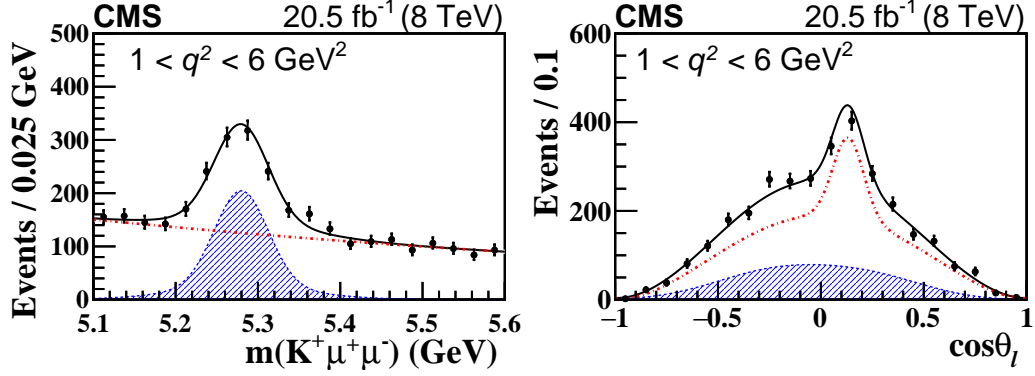


**Figure 4:** Upper limits on  $\mathcal{B}(t \rightarrow uH)$  and  $\mathcal{B}(t \rightarrow cH)$  at 95 % CL (left), and the best fit signal strength for Hut (center) and Hct (right), which is restricted to positive values in the fit.

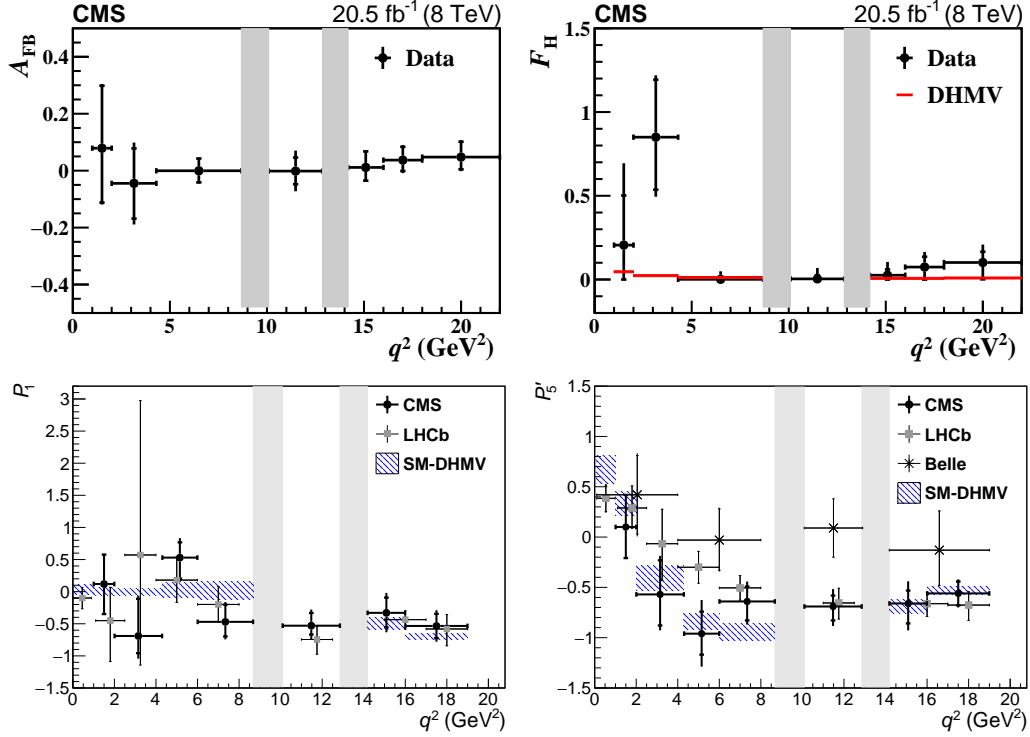


**Figure 5:** Summary of the current 95% confidence level observed limits on the branching ratios of the top quark decays via flavour changing neutral currents to a quark and a neutral boson by the ATLAS and CMS Collaborations compared to several new physics models.

- [2] CMS Collaboration, *Search for the flavor-changing neutral current interaction of the top quark and the Higgs boson which decays into a pair of  $b$  quarks at  $\sqrt{s} = 13$  TeV, accepted for publication in JHEP* <https://cds.cern.ch/record/2296416>, CERN-EP-2017-309 [hep-ex/1712.02399].
- [3] CMS Collaboration, *Angular analysis of the decay  $B^+ \rightarrow K^+ \mu^+ \mu^-$  at  $\sqrt{s} = 8$  TeV*, <https://cds.cern.ch/record/2621370> CERN-EP-2018-125 [hep-ex/1806.00636].
- [4] To be filled.
- [5] To be filled.
- [6] CMS Collaboration, *Measurement of angular parameters from the decay  $B^0 \rightarrow K^{*0} \mu^+ \mu^-$  at  $\sqrt{s} = 8$  TeV*, <https://cds.cern.ch/record/2287571>, CERN-EP-2017-240 [hep-ex/1710.02846].
- [7] To be filled.
- [8] To be filled.



**Figure 6:** Projections of the  $K^+\mu^+\mu^-$  invariant mass distribution (left) and the  $\cos\theta_l$  distribution (right) from the two-dimensional fit of data, in the  $1 < q^2 < 6 \text{ GeV}^2$  range. The solid lines show the total fit, the shaded area the signal contribution, and the dash-dotted lines the background.



**Figure 7:** Measurements of the  $A_{FB}$  (top left) and  $F_H$  (top right) parameters versus  $q^2$  for  $B^+ \rightarrow K^+\mu^+\mu^-$  decays. Measurements of the  $P_1$  (bottom left) and  $P'_5$  (bottom right) angular parameters versus  $q^2$  for  $B^0 \rightarrow K^{*0}\mu^+\mu^-$  decays. The CMS results are compared to SM DHMV theoretical predictions [4, 5] and, for the  $P_1$  and  $P'_5$  parameters, they are also compared to results from the LHCb [7] and Belle [8] Collaborations.