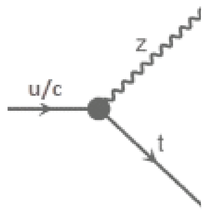

A study of tZ FCNC trends using Effective field theory at FCC energies

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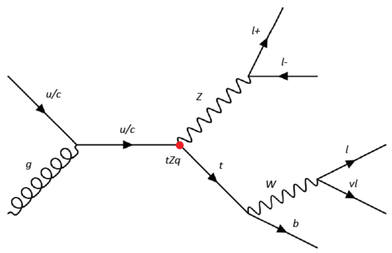
ABSTRACT

This study investigates the FCNC processes involving tZ production (ug→tZ, cg→tZ) within a simulated CMS detector environment. Utilizing an effective field theory (EFT) Lagrangian, we aim to evaluate the detection efficiency of these BSM processes at higher energy scales. Specifically, we focus on their sensitivity to variations in coupling constants. Our findings reveal a substantial enhancement in the tZ FCNC cross-section at FCC-hh energies. This suggests a promising avenue for further exploration, indicating that the t→qZ FCNC channel may no longer be significantly constrained at these elevated energy levels.



t→qZ process under investigation, made to decay leptonically
Fig. 1

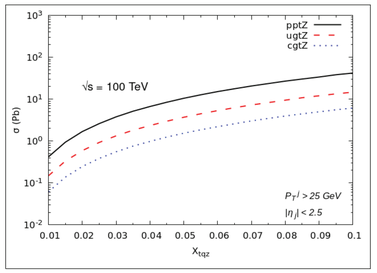
THEORY

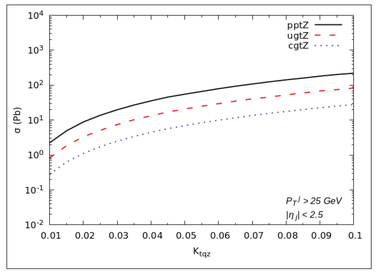
The EFT lagrangian utilized is given as,

$$-L_{\text{eff}} = \sum_{q=u,c}\left[\frac{g}{2C_W}\kappa_{tqZ}\bar{q}\frac{\iota\sigma^{\mu\nu}q\nu}{\Lambda}(\kappa_L P_L + \kappa_R P_R)tZ_\mu + \frac{g}{2C_W}X_{tqZ}\bar{q}\gamma^\mu\frac{\iota\sigma^{\mu\nu}q\nu}{\Lambda}(X_L P_L + X_R P_R)tZ_\mu\right] + H.c.$$

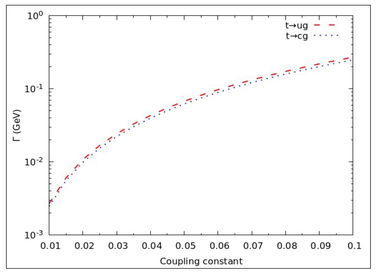
PL,R = left and right handed Chirality projector operators
K_{tqz}, X_{tqz} = Effective coupling constants
$K_{L,R}$, $X_{L,R}$ = Complex Chiral parameters

Coupling Constant trends

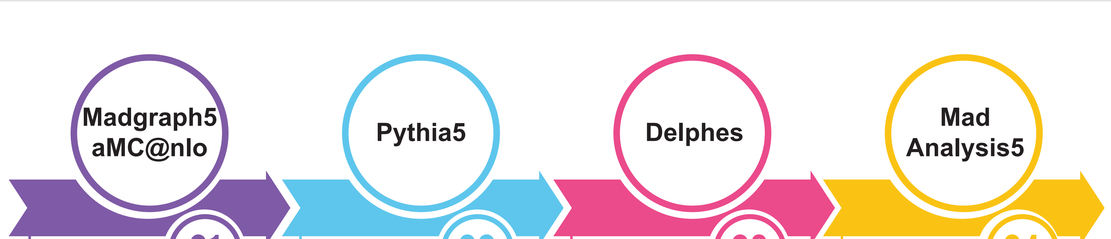




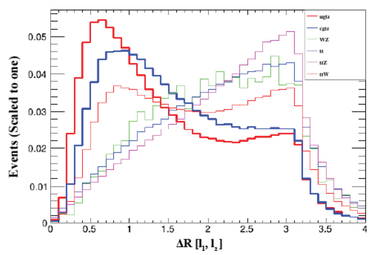
Cross section σ dependence on the FCNC coupling parameters XtqZ (left) and KtqZ (right) at FCC-hh energies (√s = 100 TeV) with the basic cuts
Fig. 2



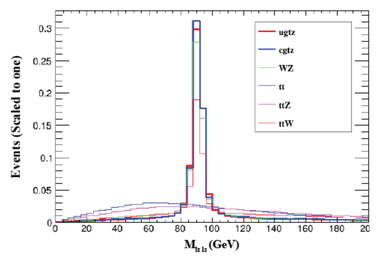
Partial width trend of t→ug, cg with respect to the BSM coupling constants
Fig. 3



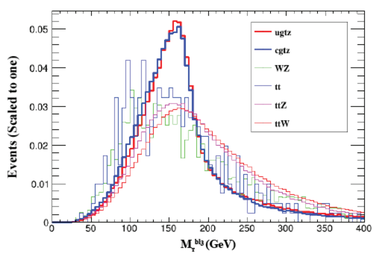
ANALYSIS RESULTS



Lepton pair



Z Boson



t quark

S/B

Table 1. Events of Signal and Background kept after every Cut

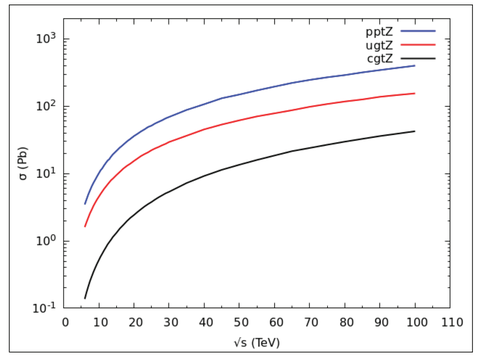
Cuts	Signals		Backgrounds			
	$ugtZ$	$cgtZ$	$t\bar{t}$	$t\bar{t}W$	$t\bar{t}Z$	WZ
Basic	476206	527100	576531	749302	673035	15970
Cut 1	70228	85454	53	154293	83084	1468
Cut 2	46438	53270	31	77528	38030	731
Cut 3	38295	43857	7	41548	4490	576

Table 2. Signal vs background efficiency after every cut

Cuts	Signal	Background	S/B
Basic	1003306 +/- 706	2014838 +/- 817	577.515 +/- 0.348
Cut 1	155682 +/- 378	238898 +/- 456	247.840 +/- 0.505
Cut 2	99708 +/- 307	116320 +/- 329	214.524 +/- 0.535
Cut 3	82152 +/- 280	46621 +/- 211	228.932 +/- 0.565

FUTURE PROSPECTS

There is a significant increase in the cross section which may well be an indicator that at energies of 100 TeV, the GIM mechanism doesn't restrict the tZ FCNC channel.



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