Introduction

- Goal : search for top FCNC/H at production, using single top produced in associations with a boson.

- Strategy followed for the 7/8TeV case :
  - Perform a study of the sensitivity of pp>tZ production at the LHC.
    - Pheno paper, including hadronization and fastsimulation of a CMS-like detector (Delphes).
    - Only " non precise" results, order of magnitudes : show the relevance of the tZ signature, no more…
  - Perform the measurement with the CMS data (only 7TeV for now).

- Advantages of going for a pheno paper (first) :
  - Present the theoretical context in details : construction of effective lagrangian, implementation in MG, validation.
  - "Feasibility" studies done outside the CMS world : MC production easier (FastDetector), easy analysis, faster publication.
  - Theorist can easily sign ! This is not always the case within CMS.

- Disadvantages (for CMS) : we let ATLAS know about interesting channels…

Plan for 13 TeV pheno

- A large variety of decay channels for tZ and tH :
  - Many decay channels, up to 5 leptons or 6 jets.
  - Same signatures can be sensitive to different anomalous couplings : give priority to exclusive interpretation.
  - Balance between cross section and background.

- tγq : need to validate gamma within Delphes first (Eric)

- tgq : all tV/H signatures are **ALL** sensitive to gqt anomalous couplings => need to cover a channel only sensitive to gqt.

Njets → / Nlept ↓	0	2	4	6
0		tH(bb)->3b (0.1pb) t->b(0.1pb) tZ->b+ 2nu (0.1pb) QCD, Zjets	tZ->b (0.1pb) QCD, tt(600pb)	tH(WW)->b (0.1pb) QCD,tt
1	tH(bb)->3b+nu (0.1pb) t->b+nu (0.1pb) tZ->b+3nu (0.01pb) Single top (5pb), tt (20 pb)	tZ->b+nu (0.1pb) Single top (5pb), tt (200 pb)	tH(WW)->b+nu (0.1pb) tH(ZZ)->b+nu (0.1pb) Single top (5pb), tt (200 pb)	
2		tZ->b (0.01pb) tH(WW)->os(ss)+b+nu (0.01pb) tt(30pb),ttV(0.30pb)		
3	tZ->b+nu (0.1pb) tH(WW)->b+3nu (0.01pb) VVjets(10pb), ttV(0.01pb)	tH(ZZ)->b+nu (0.001pb) VVjets(10pb), ttV(0.01pb)		
4		tH(ZZ)->b (0.001pb) VVjets(0.012pb) ttV(10-4)		
5	tH(ZZ)->b+nu (0.001pb)			

njets → / nlept ↓	0	2	4	6
0	Large QCD bkg Triggers ? →	tZ->b+ 2nu (0.1pb) QCD, Zjets		QCD,tt
1	tH(bb)->3b+nu (0.1pb) t->b+nu (0.1pb) tZ->b+3nu (0.01pb) Single top (4pb), tt (160 pb)	tZ->b+nu (0.1pb) Single top (4pb), tt (160 pb)	tH(WW)->b+nu (0.1pb) tH(ZZ)->b+nu (0.1pb) Single top (4pb), tt (160 pb)	
2		tZ->b (0.01pb) tH(WW)->os(ss)+b+nu (0.01pb) tt(32pb),ttV(0.25pb)		
3	tZ->b+nu (0.1pb) tH(WW)->b+3nu (0.01pb) VVjets(6pb), ttV(0.013pb)	tH(ZZ)->b+nu (0.001pb) VVjets(6pb), ttV(0.013pb)		
4		tH(ZZ)->b (0.001pb) VVjets(0.012pb) ttV(10-4)		
5	tH(ZZ)->b+nu (0.001pb)			

Njets → / nlept ↓	0	2	4	6
0		tZ->b+ 2nu (0.1pb) QCD, Zjets		
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2		tZ->b (0.01pb) tH(WW)->os(ss)+b+nu (0.01pb) tt(32pb),ttV(0.25pb)		
3	tZ->b+nu (0.1pb) tH(WW)->b+3nu (0.01pb) VVjets(6pb), ttV(0.013pb)			
4	Clear but too Small xs ?			
5	tH(ZZ)->b+			

njet / nlept	0	2	4	6
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2		tZ->b (0.01pb) tH(WW)->os(ss)+b+nu (0.01pb) tt(32pb),ttV(0.25pb)	Higgs mass Reconstruction Possible	
3	tZ->b+nu (0.1pb) tH(WW)->b+3nu (0.01pb) VVjets(6pb), ttV(0.013pb)			
4				
5	tH(ZZ)->b+			

njet / nlept	0	2	4	6
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2		tZ->b (0.01pb) tH(WW)->os(ss)+b+nu (0.01pb) tt(32pb),ttV(0.25pb)	Interesting S/B ?	
3	tZ->b+nu (0.1pb) tH(WW)->b+3nu (0.01pb) VVjets(6pb), ttV(0.013pb)			
4		VVjets(0.012pb) ttV(10-4)		
5	tH(ZZ)->b+			

Possible channels

- For gqt anomalous couplings :
  - pp->t->l+jets.
- For tZq anomalous couplings:
  - pp->tZ->3leptons,
  - pp->tZ->2leptons,
  - pp->tZ->2neutrinos,
- For tHq anomalous couplings:
  - pp->tH(WW)->same sign dilepton,
  - pp->tH(bb)->l+jets,
  - pp->tH(ZZ)->4l+1b+2j,
  - pp->tH($\gamma\gamma$)->1l+1b+nu,
  - pp->tH($\gamma\gamma$)->1l+1b+nu,
- For tγq anomalous couplings:
  - pp->tγ->1l+1b+nu,
  - pp->tγ->2j+1b, (issue with QCD background)

First basic investigation

- Problematic : how can we determine what are the true interesting channels ?

- To answer, very simple approach :
  - Set the signal cross section to the excluded limits (for a given a.c.).
  - Implement a sample cut&count analysis (no optimization) and test it on singal + main backgrounds.
  - Check the signigicance and decide if the channel is interesting or not.

- For chosen channels, perform a more complete and elaborated analysis (optimization, TMVA ?).