

Status Report

(2023.1 - 2023.4)

Xiaonan Hou Supervisor: Hongbo Liao

2023/4/22

Xiaonan Hou

Outline



1 Analysis of ttZ'

- Official signal sample
- Top reconstruction
- Pre-selections

2 Hardware work

• ECAL DoC/DGL

3 Summary and Plans for next steps

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Analysis of ttZ'

- 1. Signal sample: Production centrally available soon Presentation: <u>PH Generator meeting</u>
- 2. Top reconstruction: (shown our results on <u>B2G-Resonances</u>)









We write our own algorithm to reconstruct the tops and also show our results in 3 levels (gen, reco-gen, reco)

- Gen level: Use the origin information and reconstruct the tops after the top decay (efficiency: 100%)
- Reco-gen level: Use our own gen-matching algorithm (lost >25% due to detector resolution)
- Reco level: define the $\chi^2 (\chi^2 = \left(\frac{\text{recoTopmass-PDGTopmass}}{\sigma_t}\right)^2 + \left(\frac{\text{recoWmass-PDGWmass}}{\sigma_W}\right)^2$) and select top can didates based on best value (σ is the RMS from reco-gen level) 2023/4/22 Xiaonan Hou





Purity study: 1TeV, 3TeV

total top	top1	top2	top3	top4
Purity (without gen cuts)	78.94%	62.69%	51.53%	42.17%
	89.28%	70.18%	50.71%	38.38%
Purity (with gen cuts)	82.85%	65.95%	54.11%	45.14%
	92.82%	75.83%	54.62%	41.17%

Analysis of ttZ'

3. Pre-selections:

01

- >=6 jets for all categories
- number of b jets for each category:

boosted W boosted top	0	1	>=2
0	>=3L, >=2M, >=1T	>=2L, >=1M	>=1L
>=1	>=2L, >=1M	>=1L	/

4. Background study:



We will define our category in terms of total top multiplicity and also the boosted top multiplicity





Hardware work



1. ECAL DoC/DGL:

02

monitor the beam and splashes: Beam 1 (upper) comes from the +side, Beam 2 comes from the -side

PLUS side missed because

was too early when CMS is

was too early when CMS is

triggered for readout



First beam of 2023!



Hardware work

Beam 1

First beam of 2023!

Beam 2



Bit 166 EG28 trigger plot beam1 ~20 splashes beam2 ~20 splashes beam 1 from LS 249-315; beam 2 from LS 323-399



Logarithmic scale

2023/4/22

02



Hardware work

Comments (21-Apr-2023 18:58:40)

First STABLE BEAM at 6.8 TeV of 2023!

AFS: Single_3b_2_2_2



First stable beam of 2023! Collisions!





Summary and Plans

Summary:

Analysis of ttz'

- Will have our official signal samples soon
- Write our own top reconstruction algorithm and have a good result for purity and top mass
- Give a talk on B2G-Resonances about our own al gorithm
- Pre-selections and selections for both signal and background

Hardware working:

• ECAL DoC/DGL: very lucky to have the chance to see the first beam and first stable beam of 2023

Plans:

Analysis of ttz'

- Optimize the event selections by expected limit
- Summarize the code of top reconstruction into an in dependent part (it could be benefited by another similar analysis)
- Will change to official signal samples soon
- Give a talk on B2G-Resonances about the selections part

Analysis of 4top:

• Write the AN about datasets, objects definition and so on.

Hardware working:

- Keep doing ECAL DoC
- Will join the HGCal sensor test in May





Thanks

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Case 1: gen level

- Use the origin information and reconstruct the tops after the top decay
- no kinematic cuts



The top and the W peak where expected

m_{w^A} (gen) [GeV]

m_{w²} (gen) [GeV]

m_{w^s} (gen) [GeV]

Case 2: gen-reco level

- Match reco candidates to gen top decays dR(gen, reco)<0.4
- For the boosted top and W we use the particle NET algorithms for ID and ak8 jets for its p4
- For the resolved leptonic top, we use MET to calculate the neutrino



- We lost >25% candidates due to the acceptance/efficiency of candidates selected at reco level
- The RMS for each case of the distributions is used for the top reconstruction at reco level 2023/4/22 Xiaonan Hou



74 Case 3: reco level. (a) mass distributions

- We define the $\chi^2 \left(\chi^2 = \left(\frac{\text{recoTopmass-genTopmass}}{\sigma_t}\right)^2 + \left(\frac{\text{recoWmass-genWmass}}{\sigma_W}\right)^2\right)$ and select top candidates based on best value
 - χ^2 renders top reconstruction best candidates independently of the top decay mode
 - tops/W candidate shown below by increasing χ^2 value



• We observe a good top mass reconstruction

Case 3: reco level. (a) mass distributions 04

Chi2



2023/4/22



- purity = (# evt where a top candidate is matched to a top at gen level)/(# selected evt)
- gen-macthing: dR(recoTop, genTop) <0.8
- gen cuts: pT> 20GeV (jets/leptons), $|\eta| \le 2.5$ (electron) (for muon is 2.4), number of gen lepton = 1
- Purity of the results (Preliminary results)
 - without gen cuts

total top	top1	top2	top3	top4	
purity	78.94%	62.69%	51.53%	42.17%	1TeV
	89.28%	70.18%	50.71%	38.38%	3TeV

• with gen cuts

total top	top1	top2	top3	top4
purity	82.85%	65.95%	54.11%	45.14%
	92.82%	75.83%	54.62%	41.17%

• Number of tops in reco level



- We reconstruct at least 2 tops in about 80% of cases
- both for 1 TeV and 3 TeV Z' mass, where boosted topology dominates
- Need to verify signal/background separation to tune the algorithm







• category1: 0 boosted top && 0 boosted W



04





- Reconstruct the tops using the same algorithm as the signal study
- Consider all kinds of top decay
- Top mass

