Status Report

(2022.5-2022.8)

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Outline

1 Analysis of ttZ’

- Check out all the samples
- Learn to plot some variables
- Cross section study
- Help to produce the signal samples

2 Analysis of 4top

- Object definition
- Cross check

3 HGCal bonding

- LD V3

4 Conferences and plans

01 Analysis of ttZ'

1. Check out all the MC samples to make sure they are complete

   sumNumEvt: number of events

   sumgenWeight: $\sum \frac{genWeight}{abs(genWeight)}$

   Compare the number on DAS and the number from events

   Ratio =1 means correct

```
2016 tttt
Files 1.0 23 23
sumNumEvt 1.0 4544000 4544000
sumgenWeight 1.0 1986568 1986568

2016 ttbar_0l
Files 1.0 146 146
sumNumEvt 1.0 107067000 107067000
sumgenWeight 1.0 106200414 106200414

2016 ttbar_1l
Files 1.0 138 138
sumNumEvt 1.0 144722000 144722000
sumgenWeight 1.0 143553998 143553998
```

2. Learn to plot some variables

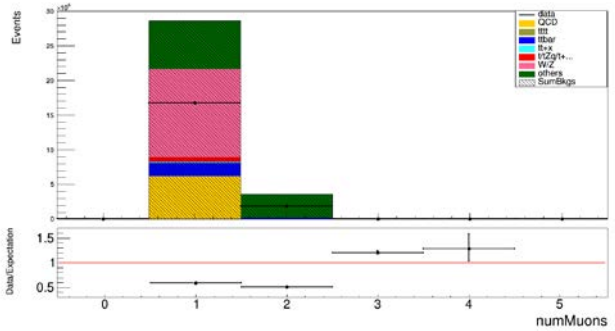
	Selection
1	Initial event
2	Trigger: HLT_IsoMu24
3	Muon>=1
4	Veto electron
5	Jets>=3

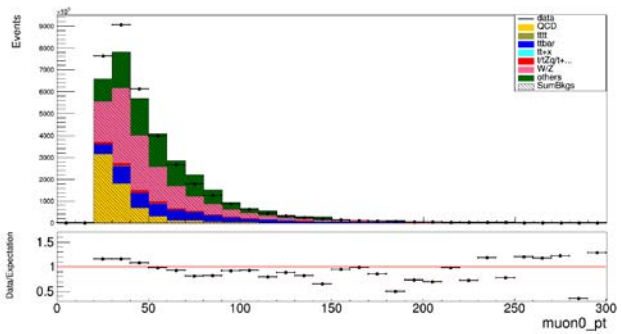
For MC samples:

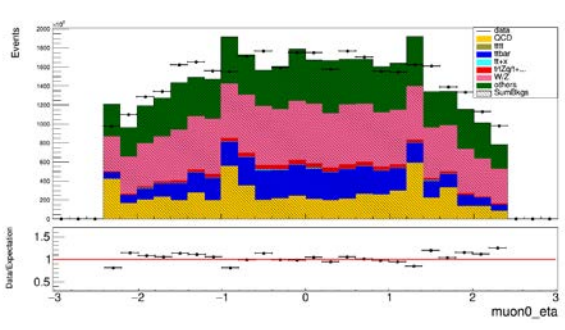
$$\text{lumiWeight} = \frac{xSec * luminosity}{sumgenweight}$$

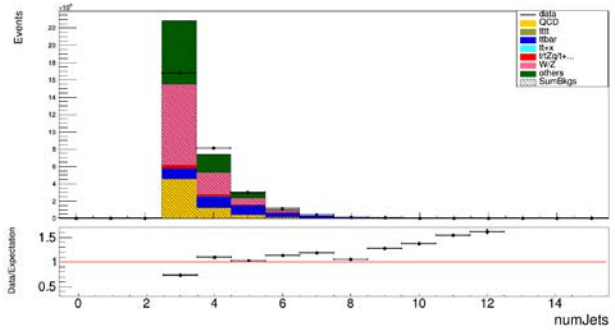
For data:

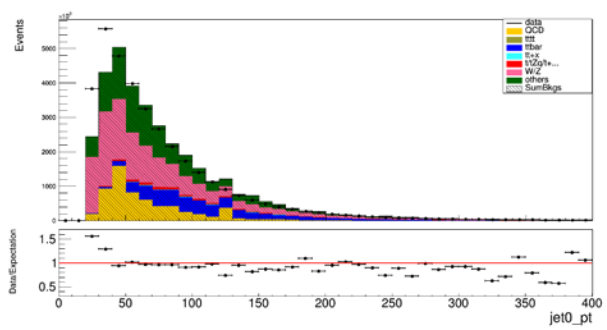
$$\text{lumiWeight} = 1$$

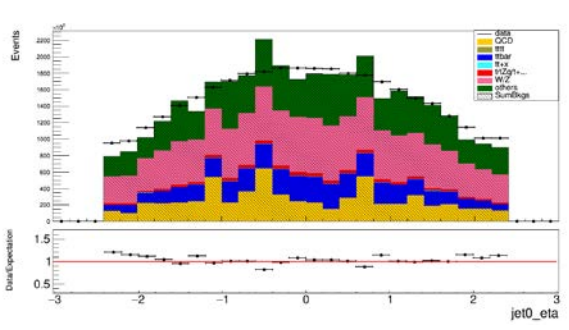












01 Analysis of ttZ'

3. Cross section study

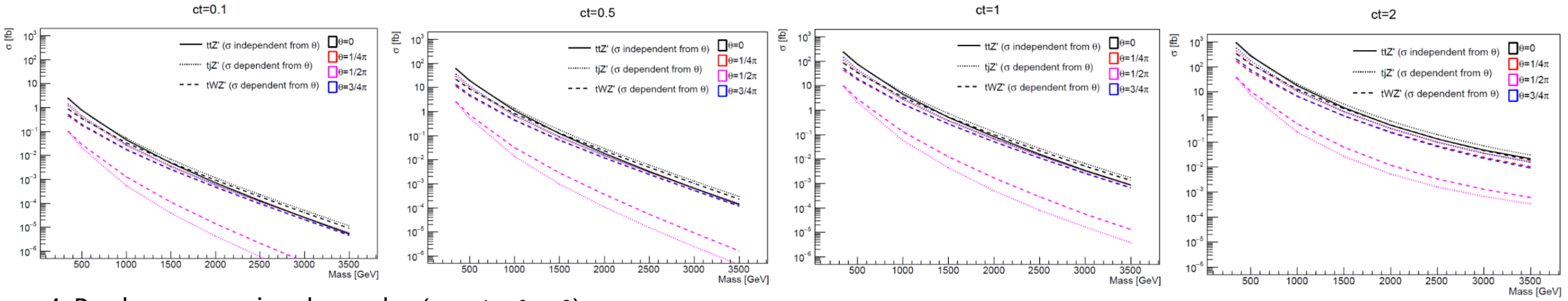
$\mathcal{L}_{int} = \bar{t}\gamma_\mu(c_L P_L + c_R P_R)tV_1^\mu = c_t\bar{t}\gamma_\mu(cos\theta P_L + sin\theta P_R)tV_1^\mu$

$P_{R/L} = (1 \pm \gamma_5)/2$ is projection operators

$c_t = \sqrt{(c_L)^2+(c_R)^2}$ is coupling of vector singlet with top quarks

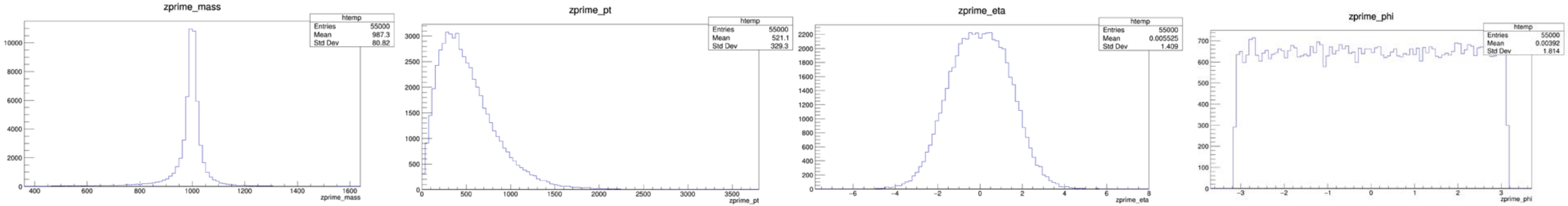
$tan\theta = c_R / c_L$ tangent of the chirality angle

➢There are three free parameters:
- The V_1 mass
- The V_1 coupling to top(c_t)
- The V_1 chirality(θ)



4. Produce some signal samples ($ct = 1,\ \theta = 0$)

use (tjz' mass point = 1TeV) as an example



02 Analysis of 4top

1. Check the object definition

ttH, 4topSS, Muon POG, Egamma POG, Tau POG, JME POG, BTV POG

Variables	Loose (WP)	Fakeable (WP)	Tight (WP)
Isolation	Electron_mvaFall17V2Iso_WP90		
d_0	0.05 cm	0.05 cm	0.05 cm
d_z	0.1 cm	0.1 cm	0.1 cm
ip3d		<4	<4
tight charge		yes	yes
Missing inner hits	<=1	0	0
Pass conversion veto	yes	yes	yes

Electron definition

Variables	Loose (WP)	Fakeable (WP)	Tight (WP)
ID	looseId	mediumId	mediumId
Isolation	MiniIsoLoose	MiniIsoTight	MiniIsoTight
d_0	0.05 cm	0.05 cm	0.05 cm
d_z	0.1 cm	0.1 cm	0.1 cm
ip3d		<4	<4
tight charge		yes	yes

Muon definition

Variables	Loose (WP)	Fakeable (WP)	Tight (WP)
d_z	<0.2	<0.2	<0.2
Decay mode finding	new	new	new
Decay mode	all	Except 5 or 6	Except 5 or 6
DeepTau vs. muons		Vloose (WP)	Vloose (WP)
DeepTau vs. electrons		VVVLoose (WP)	VVVLoose (WP)
DeepTau vs. jets	VVLoose (WP)	VVLoose (WP)	Medium (WP)
Overlap removal	loose muon and loose electron		

Tau definition

variable	
ID	Loose ID
Overlap removal	Loose leptons and loose tau

Jet definition

variable	Loose	Meidum	Tight
Deepjet	loose	medium	tight
2016APV	0.0508	0.2598	0.6502
2016	0.0480	0.2489	0.6377
2017	0.0532	0.3040	0.7476
2018	0.0490	0.2783	0.7100

B Jet definition

Analysis of 4top

2. Help to do a cross check with Huiling

my framework is based on python, Huiling' s is based on C++

use raw events, no additional corrections to MC

the same object selections, the same luminosity and cross section

cuts: metfilter -> HLT (HLT_PFHT450_SixJet40_BTagCSV_p056/ HLT_PFHT400_SixJet30_DoubleBTagCSV_p056/ HLT_PFJet450) -> baseline1 (jets number >=6) -> baseline2 (6th jet pt > 40GeV) -> baseline3 (Jets HT > 500GeV) -> 1Tau0LeptonsSR (0 tight leptons -> 1 tight tau -> >=8 jets -> >=2 medium b-jets)

process	initial	HLT	baseline1	baseline2	baseline3	1tau0l_tau	1tau0l_lep	1tau0l_jet	1tau0l_bjet
tttt	4544000.0	4232869.0	3929455.0	3168793.0	3069023.0	199098.0	129814.0	103596.0	93716.0
tt	295335000.0	32492447.0	23940015.0	11956967.0	9579382.0	187536.0	175335.0	59694.0	38251.0
qcd	106411630.0	10145831.0	2747991.0	1408590.0	1395488.0	3104.0	3101.0	962.0	138.0
ttX	40314514.0	16959947.0	13366843.0	8037490.0	7142317.0	224816.0	192634.0	86083.0	59905.0
VV	24556000.0	79220.0	29785.0	14500.0	12834.0	116.0	112.0	25.0	5.0
singleTop	9012000.0	632353.0	308059.0	132480.0	112491.0	5517.0	4337.0	1268.0	760.0
data	251352549.0	66825243.0	40897400.0	18047212.0	15245692.0	-1.0	-1.0	-1.0	-1.0
totalbg	475629144.0	60309798.0	40392693.0	21550027.0	18242512.0	421089.0	375519.0	148032.0	99059.0
totalMC	480173144.0	64542667.0	44322148.0	24718820.0	21311535.0	620187.0	505333.0	251628.0	192775.0
data/totalMC	0.52	1.04	0.92	0.73	0.72	0.0	0.0	0.0	0.0

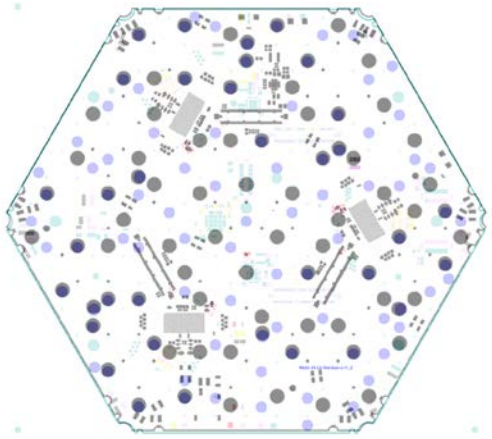
Selection	tttt	QCD	tt	ttX	single top	VV	data	totalbkg	totalMC
Ini evt	4544000	106411630	295335000	40314514	9012000	24556000	245328024(pre)	475629144	480173144
Metfilter	4533841	106249835	295074352	40251597	9000767	24539056	242184519	475115607	479649448
Trigger	4232869	10145831	32492447	16959947	632353	79220	66825243	60309798	64542667
baseline1	3929381	2747991	23939091	13366293	308005	29784	40897400	40391164	44320545
baseline2	3166730	1406650	11933314	8025776	132182	14475	18006537	21512397	24679127
baseline3	3068926	1395405	9578622	7141900	112472	12834	15244363	18241233	21310159
1tau0l 1Tau	199445	3104	187898	225204	5525	116	-1	421847	621292
latu0l 0l	130037	3101	175683	192961	4345	112	-1	376202	506239
1tau0l Jets	103778	962	59806	86198	1268	25	-1	148259	252037
1tau0l BJets	93880	138	38326	59972	760	5	-1	99201	193081

2016 Raw events

Almost the same

03 HGCal bonding

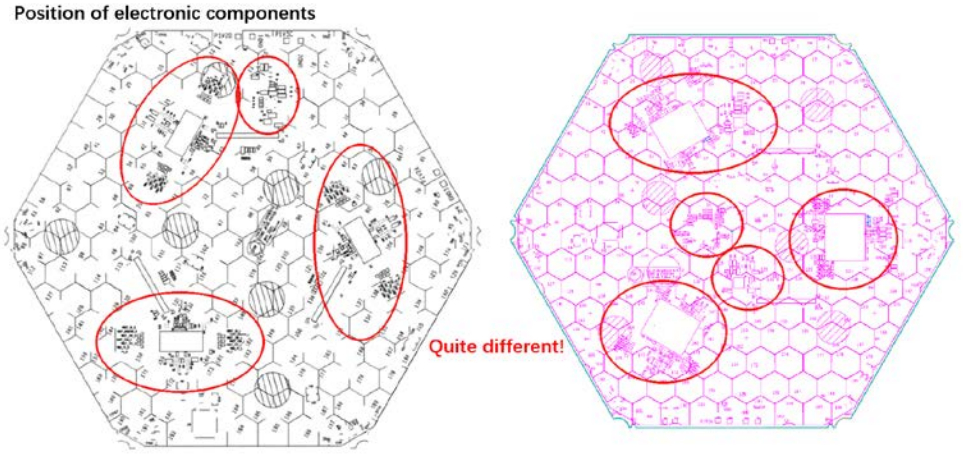
1. Compare the differences between V2 and V3



black holes -- V2

purple holes -- V3

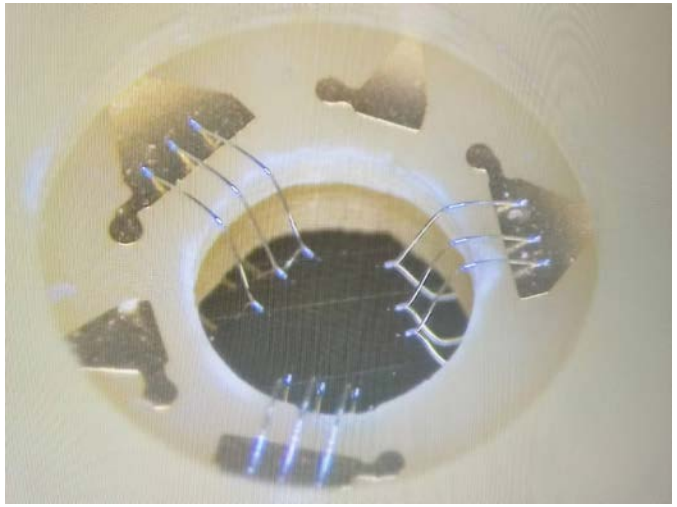
really different!

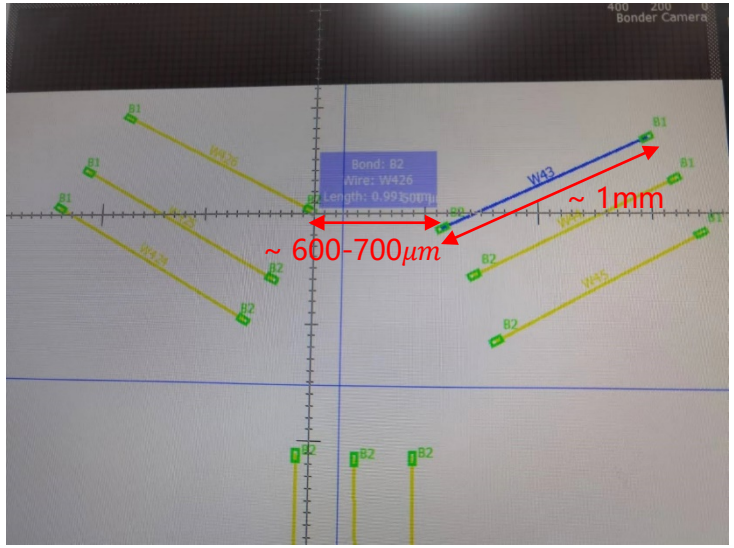


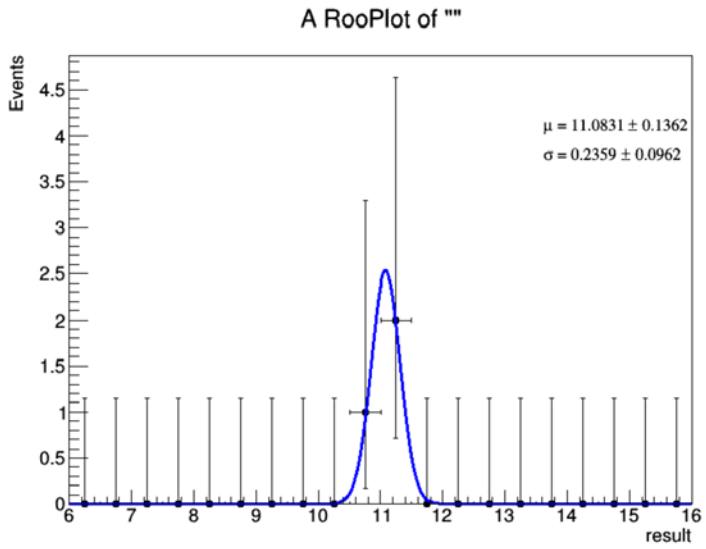
Previous: EDMS #EDA-04318-V2

Present: EDMS #2686984

2. Use a stephole dummy to do some test







Conferences and Plans

Conferences: CMS China (2022.7.2-7.3)

Plans:

Analysis of ttz’

- Produce all the signal samples and do the signal efficiency
- Learn to add other corrections and make background estimation

Analysis of 4top:

- Use all the data and MC samples to do the cross check with Huiling
- Add other corrections to do the cross check with Huiling

HGCal bonding:

- Do some test with step-hole parameters
- Waiting for the production

Thanks