

Status report

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HYU / IP2I

Jet Energy Resolution

nanoAOD production applying JER

- Joining the Path with EDProducer `cms.Path(process.slimmedJetsSmeared*process.nanoSequenceMC*process.nanoAOD_selection)`
- Nothing is changed...!

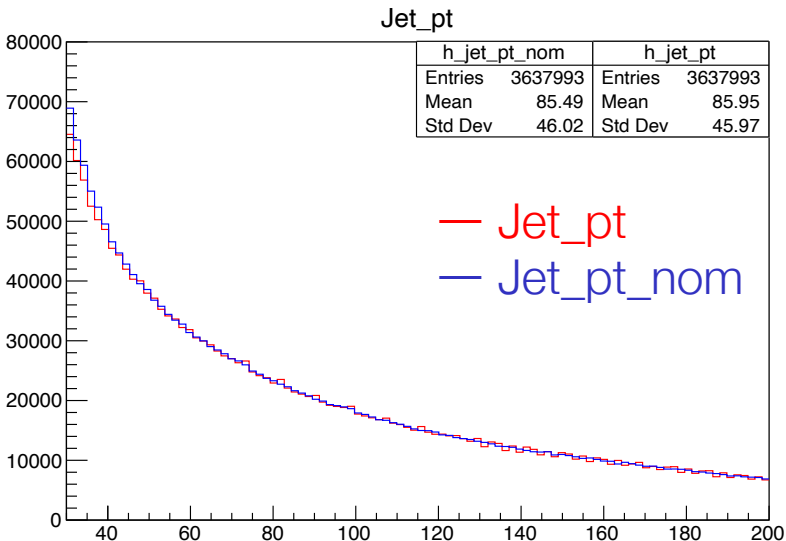
Applying JER on the fly

- Postprocessing with nanoAOD-tools ([jetmetHelperRun2](#))
- JER tag: Summer19UL18_JRV2_MC
- It is working, But:
 - This effects only pT of jets
 - ? Read [PtResolution](#) while [Eta/Phi](#) are available
 - It is ordered by nanoAOD default pT value
- Submitting jobs with slurm is available !

Instance *	event *	Jet_pt *	Jet_pt_no *
0 *	279098 *	220 *	221.03529 *
1 *	279098 *	183.625 *	184.57847 *
2 *	279098 *	91.5 *	91.163963 *
3 *	279098 *	62.90625 *	61.804920 *
4 *	279098 *	62.34375 *	61.953140 *
5 *	279098 *	41.625 *	41.495857 *
6 *	279098 *	30.28125 *	31.547332 *
7 *	279098 *	29.890625 *	31.918195 *
8 *	279098 *	29.578125 *	30.647909 *
9 *	279098 *	28.40625 *	27.202032 *
10 *	279098 *	26.359375 *	27.024280 *
11 *	279098 *	22.25 *	20.792320 *

Differences

- Sample: TprimeBToTH_M-700 Summer19UL18
- Without any pre-selection
- Jet_pt: nanoAOD default
- Jet_pt_nom = Jet_pt * [smearFactor](#)
- There are not many dramatic differences



Jet Energy Resolution

Target ↓ (Random event check)

```
JET1.Pt() * JET2.Pt() * JET3.Pt() * JET4.Pt() * JET5.Pt() * JET6.Pt() * JET7.Pt() * JET8.Pt()
*****
253.39752 * 181.35542 * 123.71696 * 108.92483 * 82.058818 * 59.491237 * 32.882309 * 32.126215
*****
253.44198 * 181.36505 * 123.77475 * 108.87513 * 82.035263 * 59.507171 * 32.889785 * 32.131748 *
*****
```

↑ Prod (After applying JER / sorted by Jet_pt_nom)

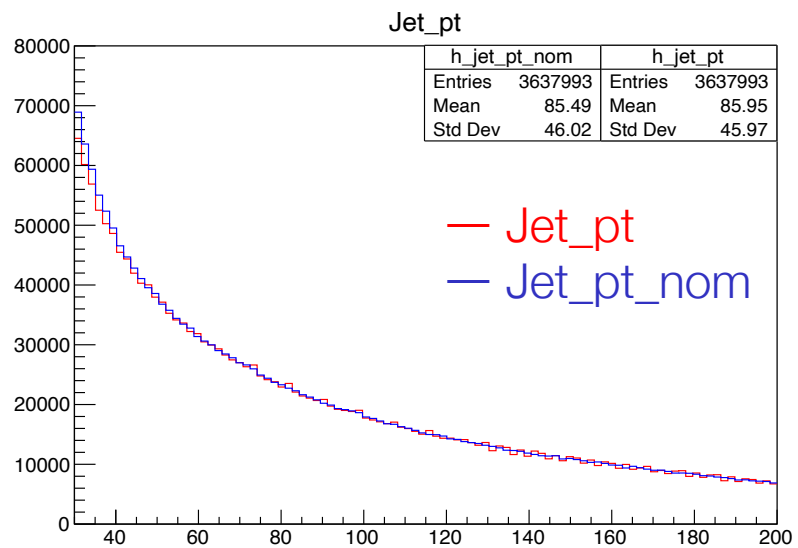
```
*****
246.625 * 180.625 * 124 * 109.4375 * 80.9375 * 58.53125 * 33.28125 *
*****
```

↑ nanoAOD default

Not selected pT < 30 GeV ↑

Differences

- Sample: TprimeBToTH_M-700 Summer19UL18
- Without any pre-selection
- Jet_pt: nanoAOD default
- Jet_pt_nom = Jet_pt * [smearFactor](#)
- There are not many dramatic differences



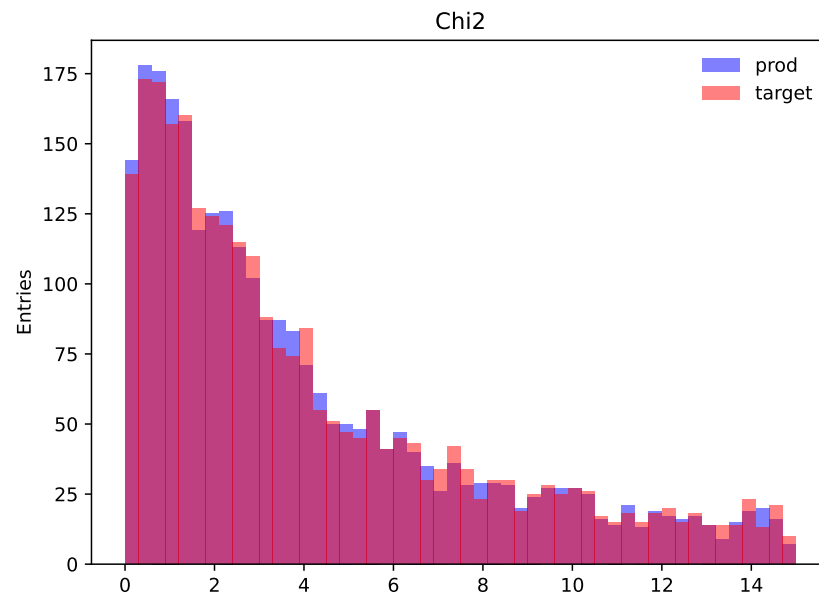
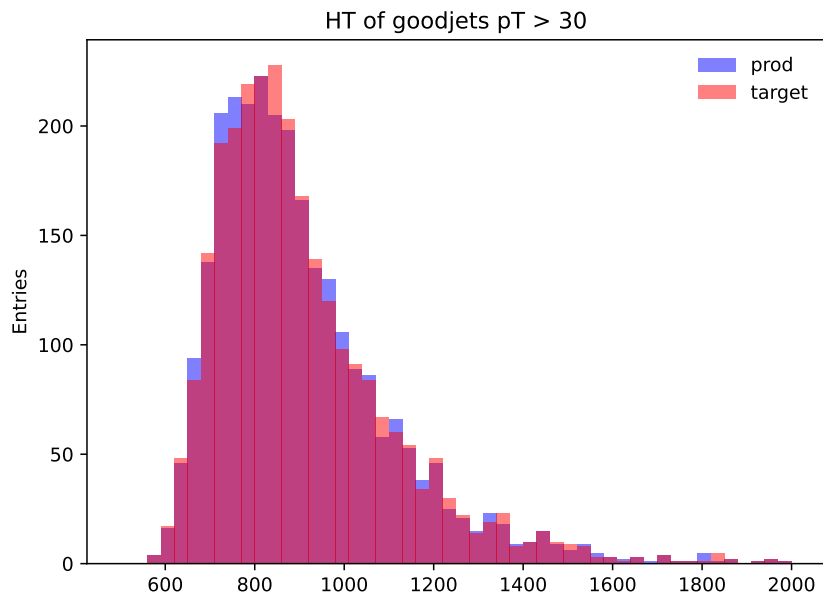
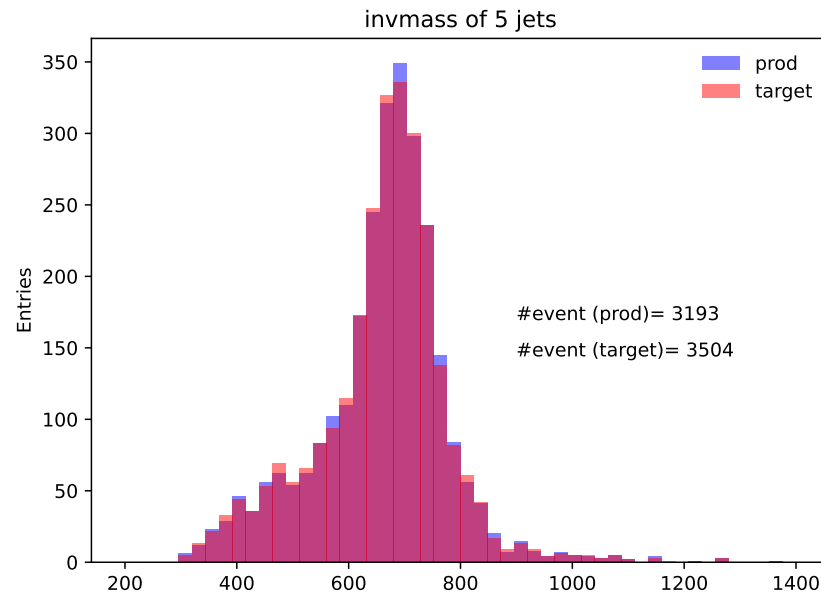
Synchronization: Recap

Adding more detail...

- Prod: nanoAOD + RDframework
- Target: miniAOD + previous result
- Number of events in common: 2640 $\rightarrow$ 2721

After Cut0:

- 1) HLT && nJets ≥ 6 && nb(DeepCSV)Jets ≥ 3
- 2) jet1pt > 170 && jet2pt > 130 && jet3pt > 80
&& HT (jets pT > 30) > 500
- 3) minimum Chi2 < 15
- 4) 2nd Top mass > 250
- 5) Higgs mass > 100



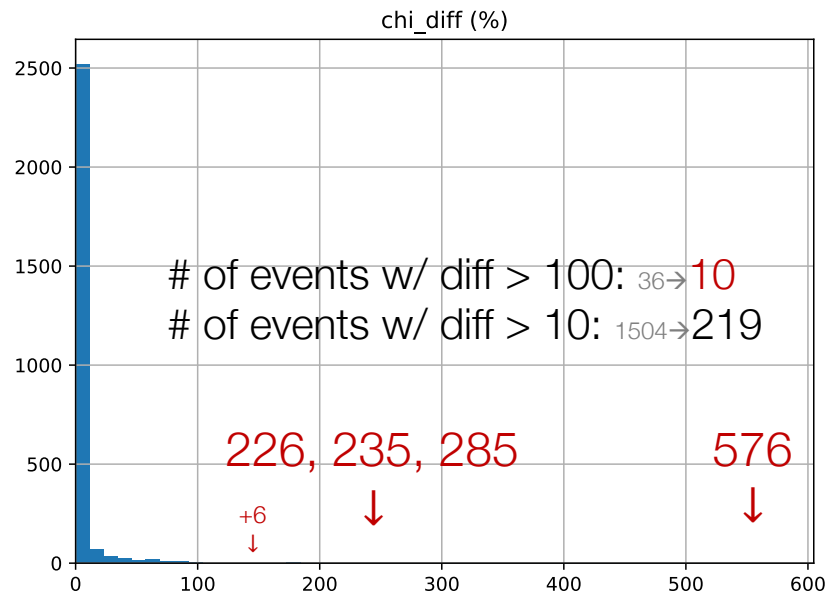
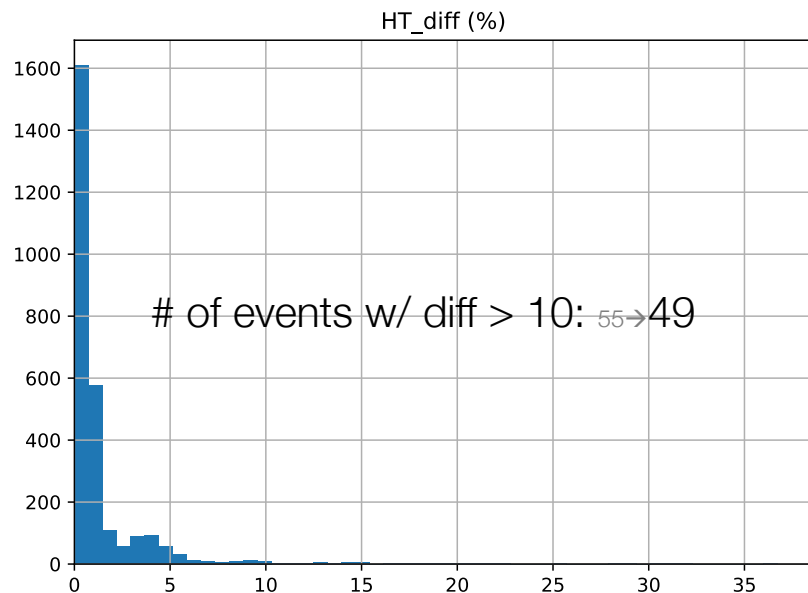
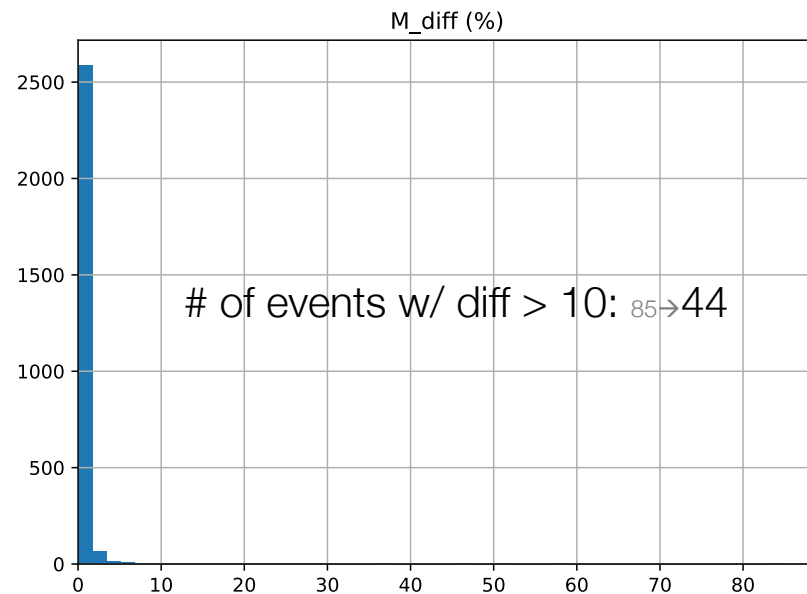
Synchronization: Recap

Adding more detail...

- Prod: nanoAOD + RDframework
- Target: miniAOD + previous result
- Diff: $|(\text{Prod} - \text{Target}) / \text{Target}| * 100$

After Cut0:

- 1) HLT && nJets ≥ 6 && nb(DeepCSV)Jets ≥ 3
- 2) jet1pt > 170 && jet2pt > 130 && jet3pt > 80
&& HT (jets pT > 30) > 500
- 3) minimum Chi2 < 15
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- 5) Higgs mass > 100



Synchronization: Diff 576%

How Chi2 assign jets (Hb1 / Hb2 / Tbj / Wj1 / Wj2)

- Target: Jet 1 / 4 / 3 / 7 / 8

```
*****
JET1.Pt() * JET4.Pt() * JET3.Pt() * JET7.Pt() * JET8.Pt() * First_Hig * Second_Hi * Top_Jet.P * First_W_J * Second_W_ *
*****
249.57854 * 97.253764 * 113.99680 * 38.409073 * 30.223437 * 249.57854 * 97.253764 * 113.99680 * 38.409073 * 30.223437 *
*****
```

- Prod: Jet 1 / 5 / 4 / 6 / 7

```
*****
selJet_pt * selJet_pt * selJet_pt * selJet_pt * selJet_pt * selJet_pt * Hb1_pt * Hb2_pt * Tbj_pt * Wj1_pt * Wj2_pt *
*****
249.55607 * 97.247901 * 112.77773 * 48.943805 * 41.426467 * 51.953102 * 249.55607 * 97.247901 * 112.77773 * 48.943805 * 41.426467 *
*****
```

Event 241745: selected jets

Target / Prod / default

```
*****
JET1.Pt() * JET2.Pt() * JET3.Pt() * JET4.Pt() * JET5.Pt() * JET6.Pt() * JET7.Pt() * JET8.Pt() *
*****
249.57854 * 153.86052 * 113.99680 * 97.253764 * 54.352136 * 50.881399 * 38.409073 * 30.223437 *
*****
249.55607 * 153.80375 * 128.05111 * 112.77773 * 97.247901 * 51.953102 * 50.883064 * 48.943805 *
*****
245.75 * 150.625 * 127 * 111.0625 * 98.8125 * 53.28125 * 48.46875 * 34.21875 *
*****
```

Synchronization: Diff 576%

```
*****
JET1.Pt() * JET2.Pt() * JET3.Pt() * JET4.Pt() * JET5.Pt() * JET6.Pt() * JET7.Pt() * JET8.Pt() *
*****
249.57854 * 153.86052 * 113.99680 * 97.253764 * 54.352136 * 50.881399 * 38.409073 * 30.223437 *
*****
```

GoodJet : Jet_pt > 30 && abs(Jet_eta) < 4.5 && Jet_jetId > 1

		pT	Eta		jetId	DeepCSV	

*	Row	*	Instance	*	sorted_Je	*	sorted_Je

*	1069	*	0	*	249.55607	*	-0.784912
*	1069	*	1	*	153.80375	*	1.7407226
*	1069	*	2	*	128.05111	*	-1.646728
*	1069	*	3	*	112.77773	*	-1.655029
*	1069	*	4	*	97.247901	*	-0.679077
*	1069	*	5	*	51.953102	*	2.7456054
*	1069	*	6	*	50.883064	*	-1.045898
*	1069	*	7	*	48.943805	*	-2.708496
*	1069	*	8	*	41.426467	*	-1.579101
*	1069	*	9	*	25.736625	*	4.2890625
*	1069	*	10	*	15.682333	*	-4.774414
*	1069	*	11	*	15.180594	*	3.5581054
*	1069	*	12	*	14.784772	*	2.6533203

[doc](#)

Jet_jetId	Int_t	Jet ID flags bit1 is loose (always false in 2017 since it does not exist), bit2 is tight, bit3 is tightLepVeto
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Synchronization: Diff ~200%

Chi2 diff 285%, 235%, 226% cases

Evt 13410 LS 135
Target: 2/**6**/3/4/7
Prod: 2/**5**/3/4/7

ce *	Jet_pt *	Jet_pt_no *	Jet_btagD *
0 *	293.75 *	294.52468 *	0.6020507 *
1 *	229 *	229.57690 *	0.7714843 *
2 *	194.375 *	192.81185 *	0.9741210 *
3 *	178.5 *	180.74330 *	0.1986083 *
4 *	91.875 *	94.150039 *	0.9726562 *
5 *	87.0625 *	86.530876 *	0.4055175 *
6 *	31 *	30.267335 *	0.0249633 *
7 *	28.828125 *	28.595356 *	-1 *
8 *	27.96875 *	27.708204 *	0.0431213 *
9 *	23.8125 *	23.968793 *	-1 *
10 *	19.984375 *	22.328764 *	-1 *
11 *	17.671875 *	21.294311 *	-1 *
12 *	15.453125 *	15.893596 *	-1 *

Out of btag condition

Evt 84294 LS 843
Target: **8** jets in condition

ce *	Jet_pt *	Jet_pt_no *
0 *	225.375 *	223.2108 *
1 *	211.375 *	217.62968 *
2 *	129.625 *	132.81222 *
3 *	128.75 *	138.30160 *
4 *	110.25 *	110.79978 *
5 *	89.9375 *	90.851097 *
6 *	43.8125 *	41.729602 *
7 *	30.046875 *	29.077970 *

Out of pT condition

Evt 327001 LS 3271
Target: **1**/4/**6**/5/**8**
Prod: **2**/7/4/5/9

Chi2 Target: 1.33
Chi2 Prod : 4.35

Higgs Chi2 with 1+4: 0.13
Higgs Chi2 with 2+7: 0.05
Then W+Top Chi2: 4.30

Misunderstanding of Chi2?

Current Procedure:

- 1) Selected bjets
→ minimize H Chi2
- 2) Selected Jets + bjet except 1)
→ minimize Top+W Chi2
- 3) Chi2 = 1) + 2)

Synchronization: Diff ~100%

Chi2 diff (%): 183, 181, 180, 172, 138, 108

Evt 159734 LS 1598
Target: 4/5/3/6/7
Prod: 4/5/3/6/7
Selecting the same jets..

Evt 91415 LS 915
Target: 3/4/5/7/8
Prod: 3/6/5/4/7

Evt 395502 LS 3956
Target: 2/5/6/4/9
Prod: 2/5/6/4/7

ce *	Jet_pt *	Jet_pt_no *
0 *	268.25 *	262.59307 *
1 *	224.25 *	224.77839 *
2 *	201.125 *	204.72361 *
3 *	176.25 *	176.65412 *
4 *	118.125 *	119.31924 *
5 *	52.125 *	57.923481 *
6 *	43.59375 *	43.396446 *
7 *	31.109375 *	29.325046 *

46.8

Out of btag condition

Out of pT condition

Evt 13975 LS 140
Target: 1/5/2/7/9
Prod: 1/5/2/3/6

Out of pT condition

Evt 239281 LS 2393
Target: 5/7/3/6/8
Prod: 5/7/3/6/8

Selecting the same jets

Evt 86964 LS 870
Target: 6/8/7/4/9
Prod: 6/8/7/4/9

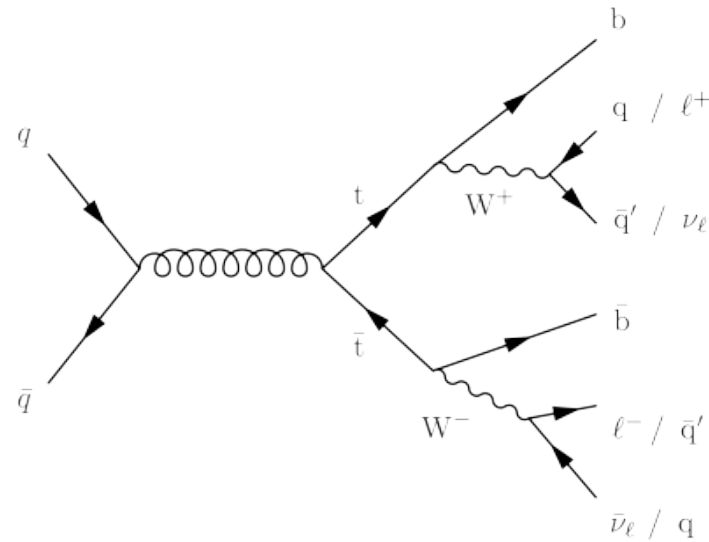
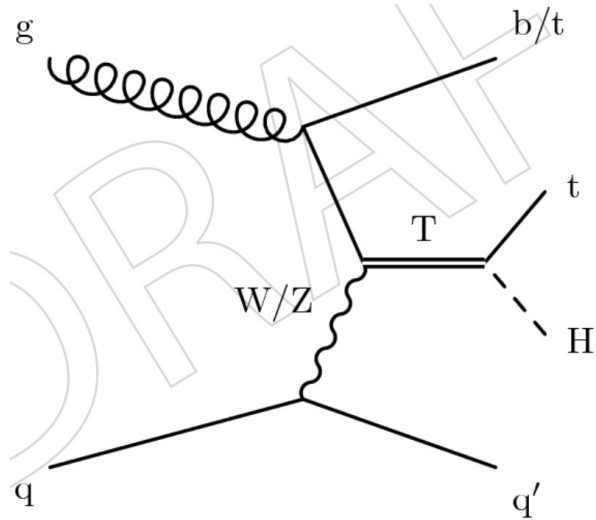
Selecting the same jets



Issues are coming from the data itself, not from the framework

NN input features

Tprime FH vs ttbar FH



- Final state: 7 jets, 4 b-tagged vs 6 jets, 2 b-tagged
- Resonances: $b+qq + bb$ vs $b+qq$

Possible discriminant variables: What is the goal for NN?

1. Discriminating events: Event variables
 - # of (b-tagged) jets, Jet HT, Punzi variables (!)
2. Assigning jets: Jet variables
 - Jet kinematics
 - $\Delta R(\text{Eta}/\text{Phi})$ between (b-tagged) jets
 - Chi^2 , invariant mass of 5 jets