Software Review: Update

26 August 2022

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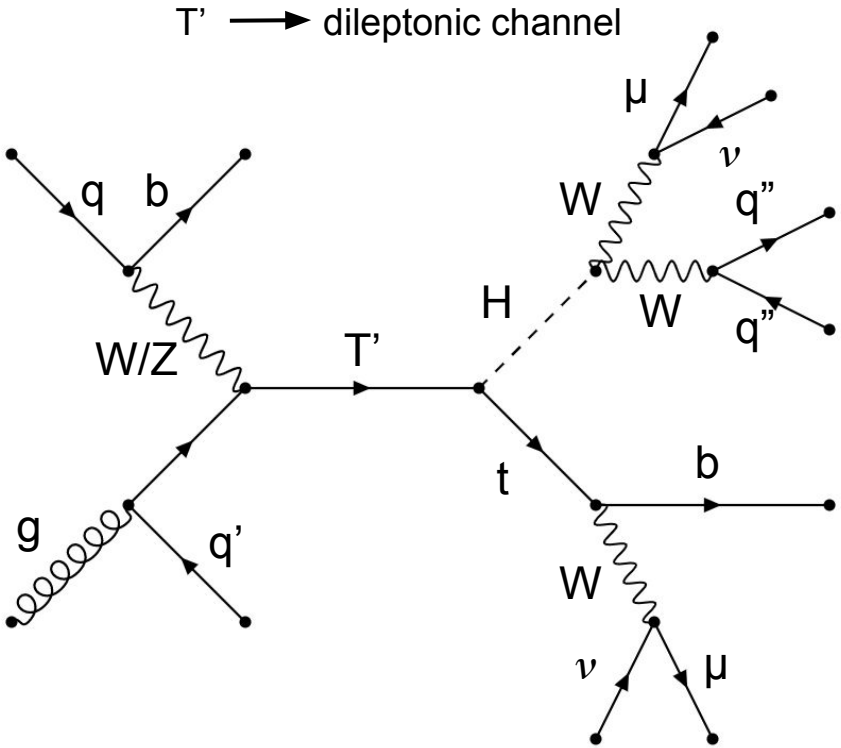


Basic selection: 2 loose Muons with Pt > 10 GeV, |η| < 2.4 and loose isolation + 2 tight SS Muons with Pt > 20 GeV, |η| < 2.4, tight isolation and sip_3d < 3.

Current analysis:

Identification of the muons: loose = loose ID, Pt > 20 GeV, |eta| < 2.4 and Muon_miniPFRelIso_all < 0.40.

tight = vetoing loose + tight ID, Pt > 20 GeV, |eta| < 2.4, Muon_sip3d < 3 and Muon_miniPFRelIso_all < 0.05.

Identification of the electrons: tight ID, Pt > 25 GeV, |eta| < 2.5, Electron_sip3d < 3 and Electron_miniPFRelIso_all < 0.05.

Cut 0: 2 Leptons SS with Sum of Pt of the two leptons > 160 GeV.

Cut 1: DeltaR between the two leptons > 1.8.

Cut 2: at least 3 jets with at least one b-jet (b-tag medium) of Pt > 50 GeV.

Cut 3: minimum of the invariant mass of the three jets with a least one b-jet > 34 GeV (Mass of the top +/- 2σ).

Analysis strategy

List of studied variables:

The T' has a large mass so we expect the top and the Higgs to have high Pt.

→ Pt of leading lepton
Pt of subleading lepton
Sum of Pt of 2 leptons
Pt of sum of 2 leptons
St = Sum of Pt of leptons and jets

Pt of leading jet
Pt of subleading jet
Pt of subsubleading jet
Pt of leading bjet
Ht = Sum of Pt of jets

The two leptons muse have the same charge and we expect them to be back-to-back.

→ Charge of leptons
Sum of charge of leptons
Number of leptons

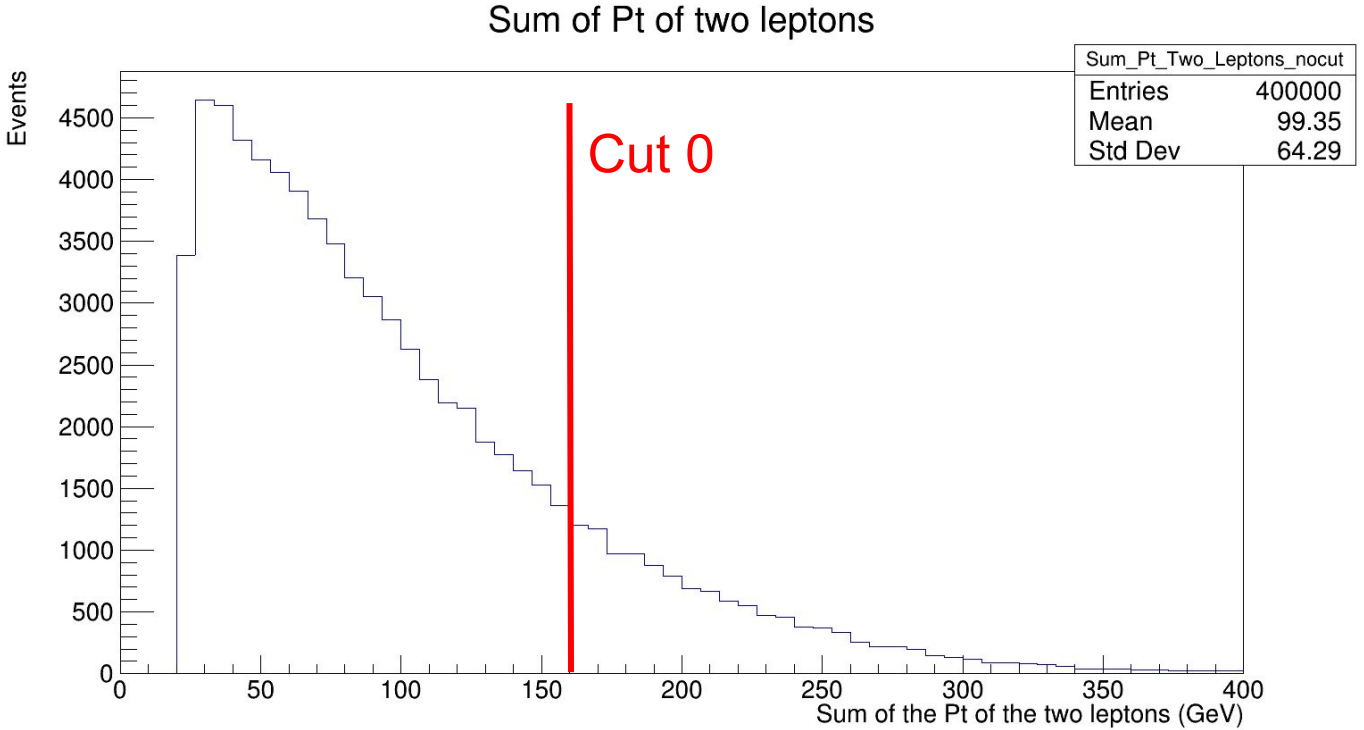
Δφ between 2 leptons
ΔR between 2 leptons
Mass of sum of 2 leptons

The top must have a non-hadronic decay.

→ Min(3 jets mass) = Minimum of (Mass of three jets with one bjet among all the jets - Mass of top quark = 172.9 GeV). We expect it to be different to 0.

Analysis strategy (All channels)

Cut 0: 2 leptons (2μ, 1μ+1e, 2e) SS with Sum of Pt of 2 leptons > 160 GeV.



Analysis strategy (All channels)

Cut 0: 2 leptons (2μ, 1μ+1e, 2e) SS with Sum of Pt of 2 leptons > 160 GeV.

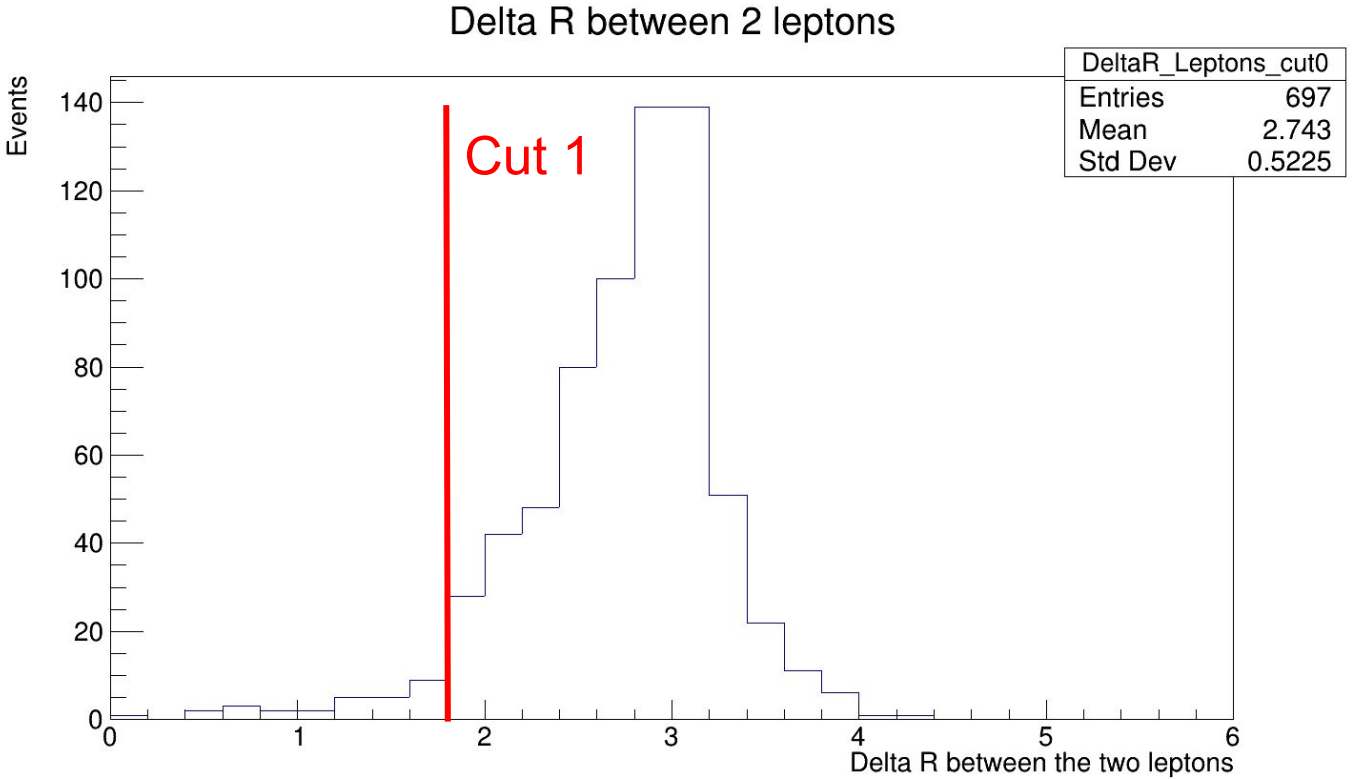
Process	Signal	ε signal (%)	P signal (%)	ttbar	ttW	WZ	S/B
Cut 0	23.3	17.0	65.3	1134.2	427.9	2565.0	0.56%

$$\varepsilon = \frac{Nb(Gen+Selection)}{Nb(Gen)} \qquad P = \frac{Nb(Selection+Gen)}{Nb(Selection)}$$

Gen = SS Leptons coming from W

Analysis strategy (All channels)

Cut 1: ΔR between 2 Leptons > 1.8.



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Cut 1	22.3	16.3	65.3	1019.6	322.3	2064.8	0.65%

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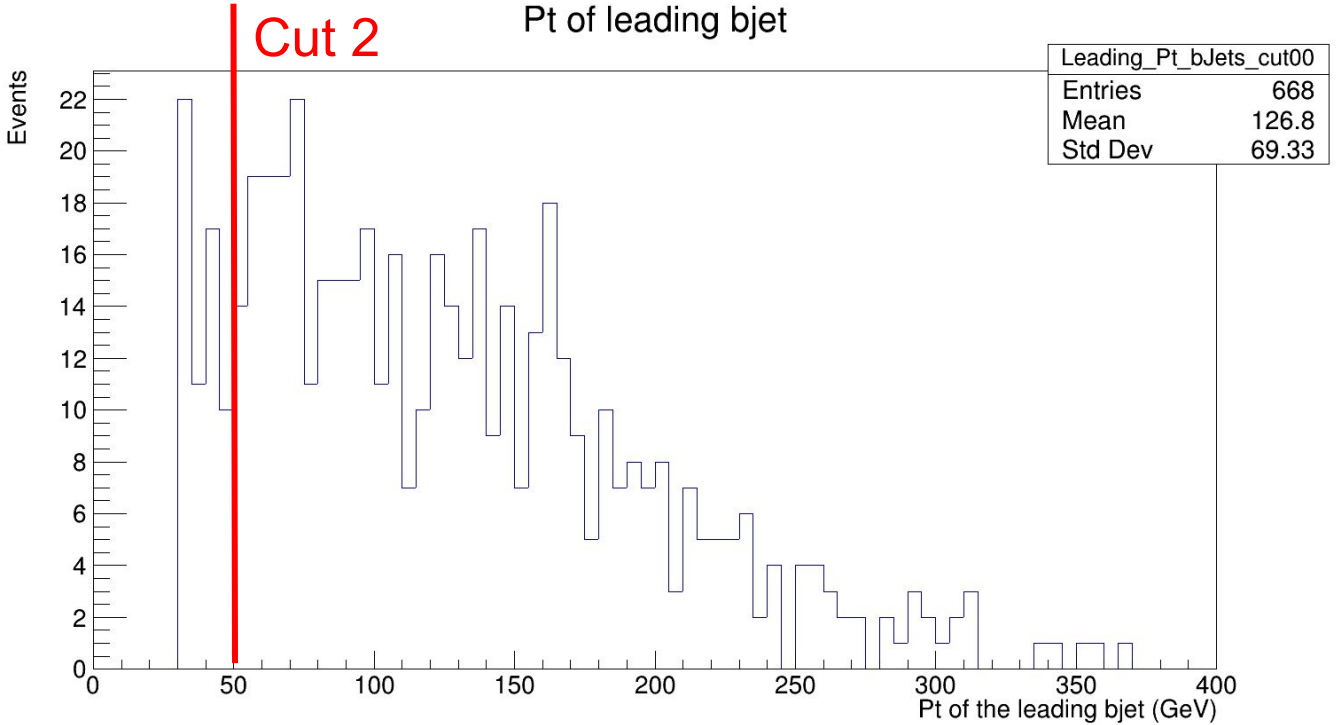
Gen = SS Leptons coming from W

Analysis strategy (All channels)

Cut 2: >= 3 jets and >= 1 bjet with Pt > 50 GeV.



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Cut 1	22.3	16.3	65.3	1019.6	322.3	2064.8	0.65%
Cut 2	13.9	10.5	68.3	352.0	214.0	21.7	2.37%

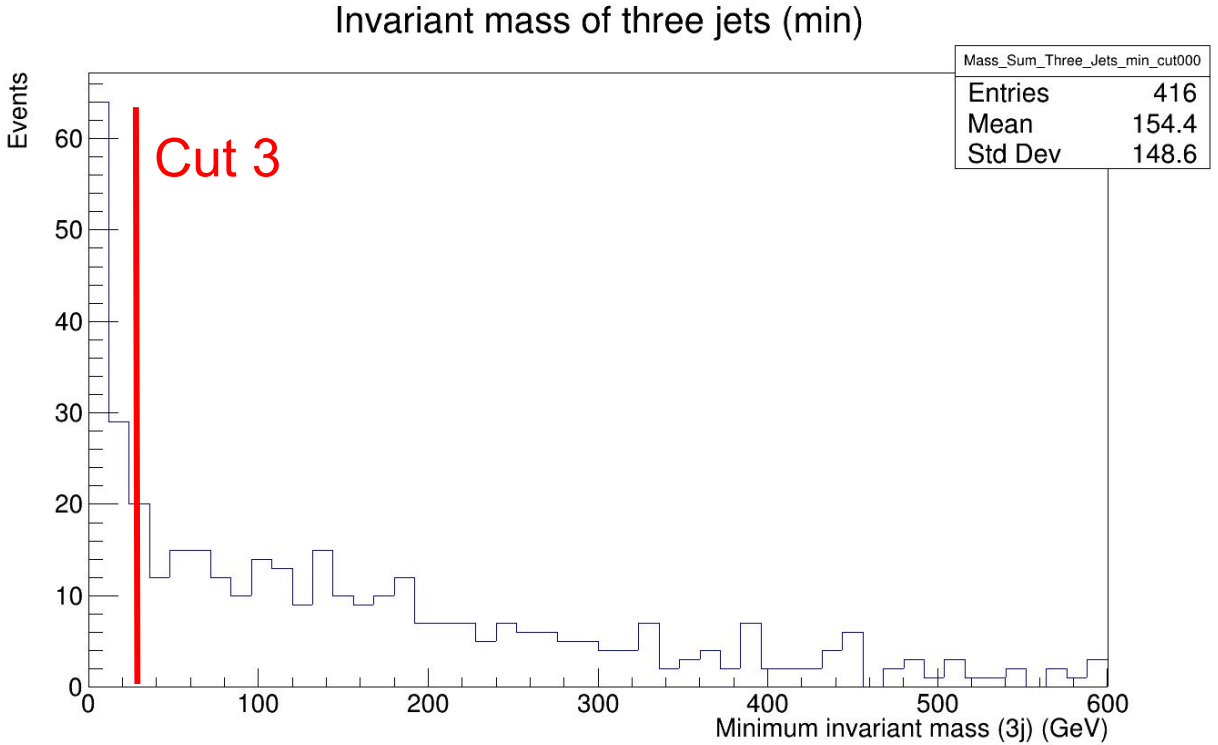
-98.9%

$$\varepsilon = \frac{Nb(Gen+Selection)}{Nb(Gen)} \qquad P = \frac{Nb(Selection+Gen)}{Nb(Selection)}$$

Gen = SS Leptons coming from W

Analysis strategy (All channels)

Cut 3: Min(3 jets mass) > 34 GeV (i.e. 3 jets mass ∉ Top mass ± 2σ).



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Cut 2	13.9	10.5	68.3	352.0	214.0	21.7	2.37%
Cut 3	10.7	8.1	67.3	273.1	109.7	17.3	2.67%

-48.7%

$$\varepsilon = \frac{\text{Nb(Gen+Selection)}}{\text{Nb(Gen)}} \qquad P = \frac{\text{Nb(Selection+Gen)}}{\text{Nb(Selection)}}$$

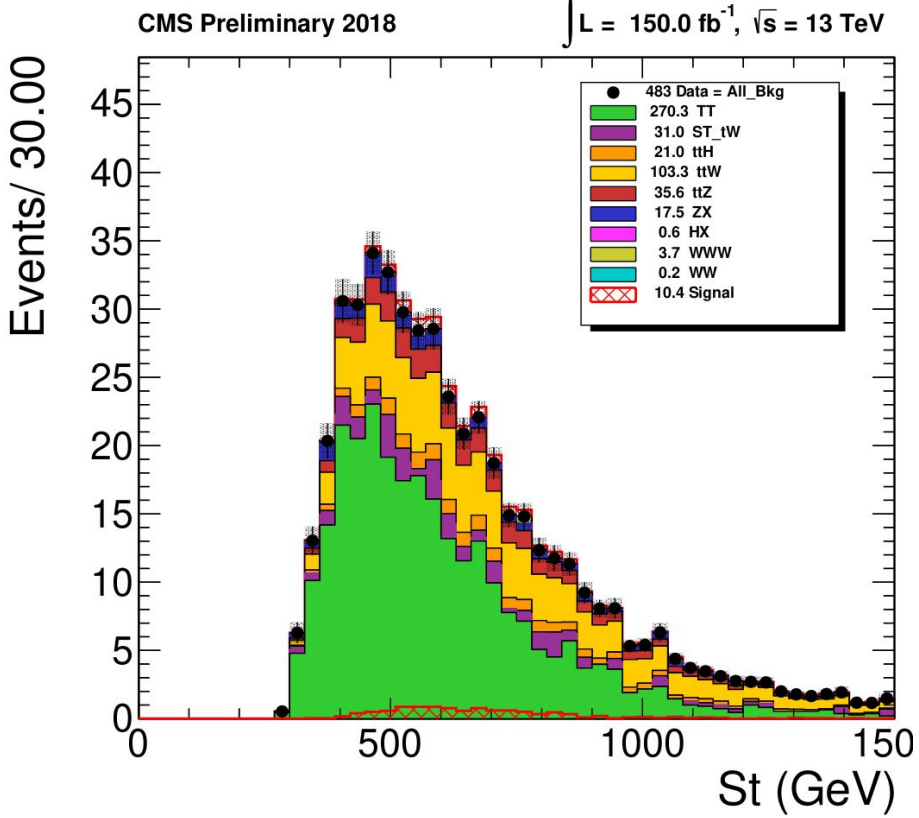
Gen = SS Leptons coming from W

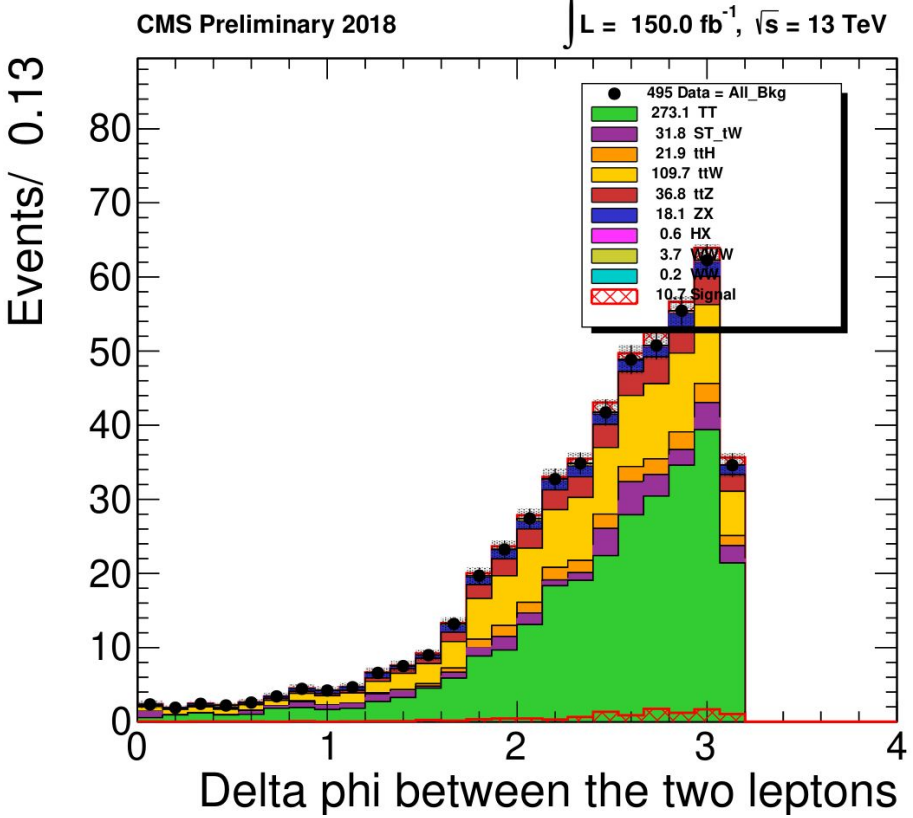
Analysis strategy (All channels)

Process	Signal	ttbar	ttW	ttZ	Single top (tW)	ttH	ZX*	WWW	HX*	WW	Others*	All Bkgs	S/B
Cut 0	23.3	1134.2	427.9	151.5	195.6	98.9	2713.0	106.9	99.8	130.7	5684.4	10742.8	0.22%
Cut 1	22.3	1019.6	322.3	108.3	163.8	67.0	2194.8	87.6	93.1	115.5	2520.5	6692.4	0.35%
Cut 2	13.9	352.0	214.0	74.4	42.8	48.5	22.8	4.4	0.8	0.2	0.0	759.8	1.83%
Cut 3	10.7	273.1	109.7	36.8	31.8	21.9	18.1	3.7	0.6	0.2	0.0	496.0	2.16%

* ZX = ZW + ZZ
  HX = HW + HZ
  Others = Drell-Yan and W+Jets

St/Δφ after Cut 3 (All channels)





Analysis strategy (2μ channel)

Process	Signal	ε signal (%)	P signal (%)	ttbar	ttW	WZ	S/B
Cut 0	8.2	22.5	65.7	37.7	143.6	412.2	1.38%
Cut 1	7.9	21.9	66.0	30.8	108.8	332.9	1.67%
Cut 2	4.9	14.4	70.0	11.3	73.4	3.1	5.58%
Cut 3	4.0	12.1	72.5	8.9	38.0	2.4	8.11%

$$\varepsilon = \frac{\text{Nb(Gen+Selection)}}{\text{Nb(Gen)}} \qquad P = \frac{\text{Nb(Selection+Gen)}}{\text{Nb(Selection)}}$$

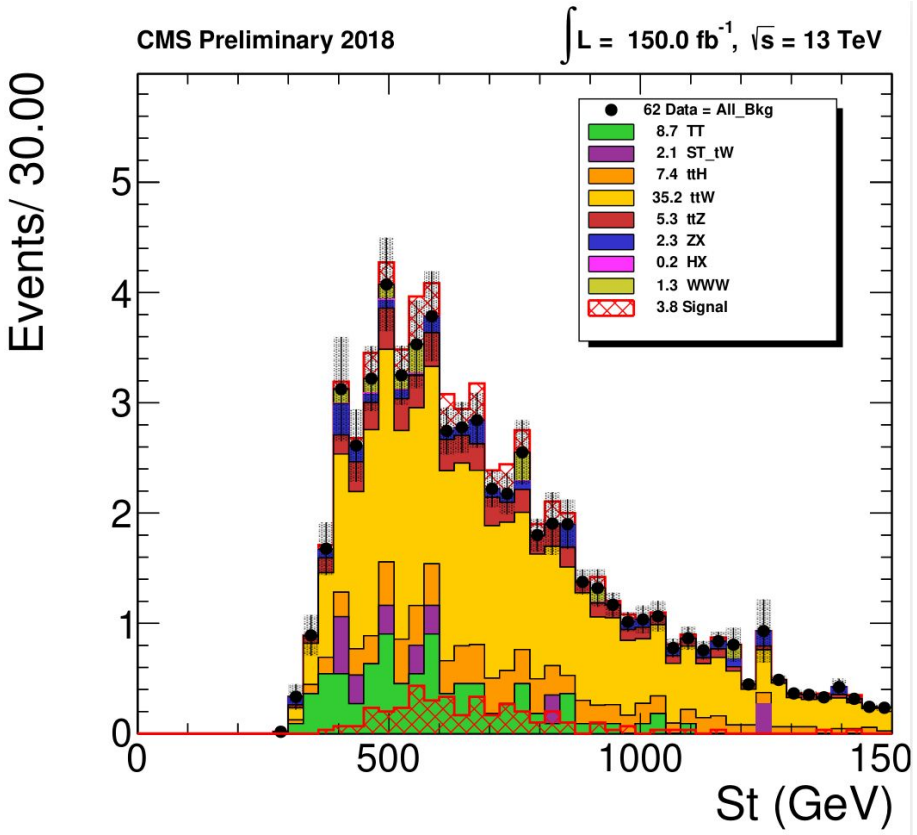
Gen = SS Leptons coming from W

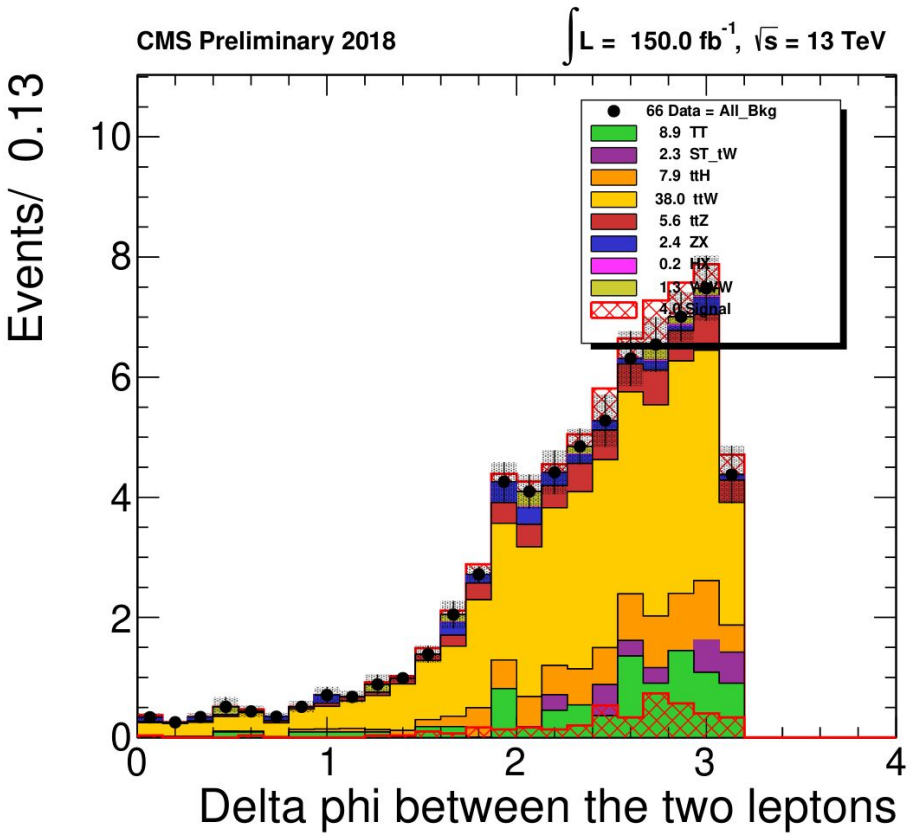
Analysis strategy (2μ channel)

Process	Signal	ttbar	ttW	ttZ	Single top (tW)	ttH	ZX*	WWW	HX*	Others*	All Bkgs	S/B
Cut 0	8.2	37.7	143.6	22.3	16.6	35.2	424.8	33.0	31.1	236.4	980.6	0.84%
Cut 1	7.9	30.8	108.8	16.2	13.9	23.7	343.8	27.5	29.1	113.5	707.4	1.12%
Cut 2	4.9	11.3	73.4	11.3	3.9	17.6	3.2	1.4	0.3	0.0	122.3	4.01%
Cut 3	4.0	8.9	38.0	5.6	2.3	7.9	2.4	1.3	0.2	0.0	66.7	6.00%

* ZX = ZW + ZZ
  HX = HW + HZ
  Others = WW, Drell-Yan and W+Jets

St/Δφ after Cut 3 (2μ channel)





Analysis strategy (1μ+1e channel)

Process	Signal	ε signal (%)	P signal (%)	ttbar	ttW	WZ	S/B
Cut 0	11.2	16.3	67.1	644.7	208.7	1338.9	0.51%
Cut 1	10.6	15.5	67.1	577.7	157.6	1080.5	0.58%
Cut 2	6.7	10.1	70.0	204.1	104.2	11.4	2.10%
Cut 3	5.1	7.4	68.0	157.3	53.3	8.7	2.33%

$$\varepsilon = \frac{\text{Nb(Gen+Selection)}}{\text{Nb(Gen)}} \qquad P = \frac{\text{Nb(Selection+Gen)}}{\text{Nb(Selection)}}$$

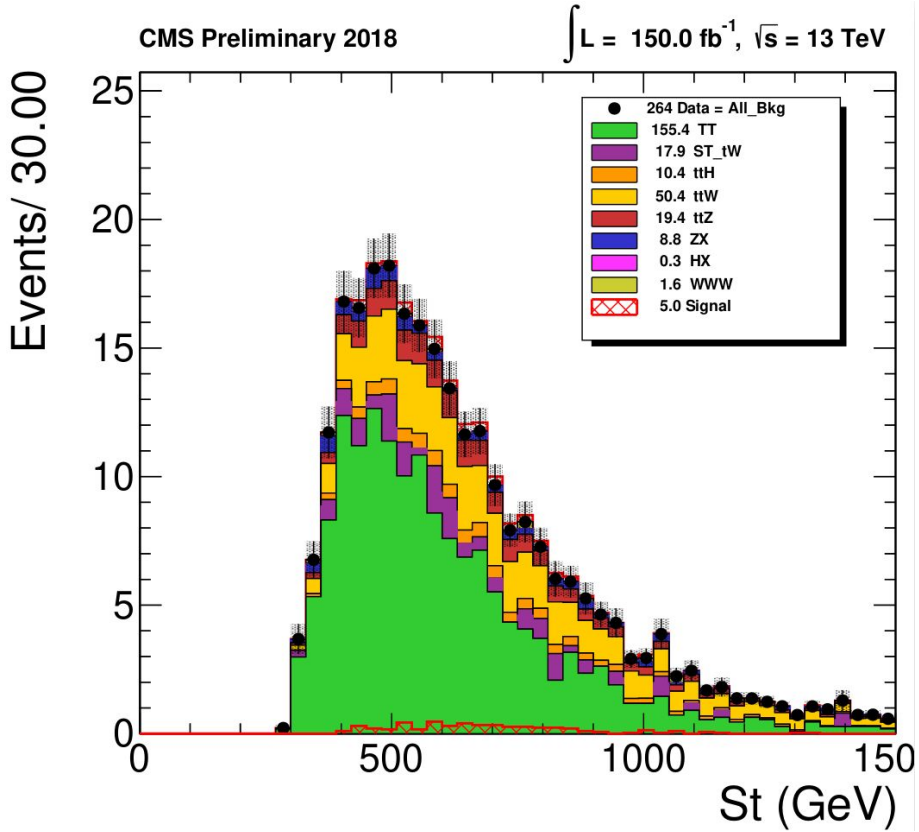
Gen = SS Leptons coming from W

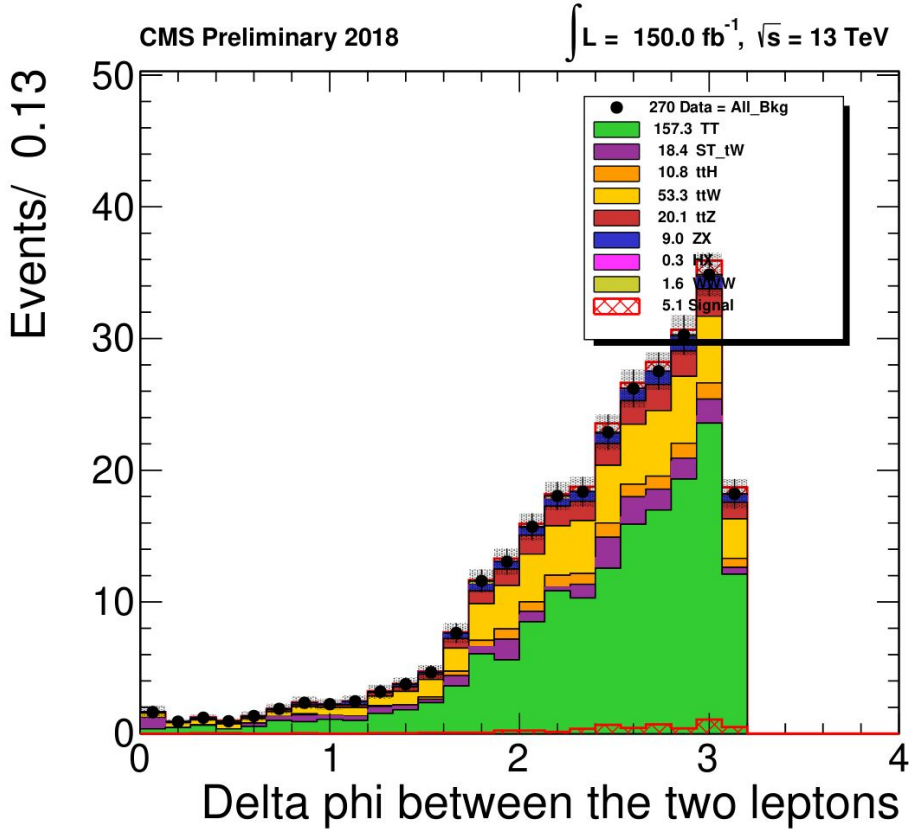
Analysis strategy (1μ+1e channel)

Process	Signal	ttbar	ttW	ttZ	Single top (tW)	ttH	ZX*	WWW	HX*	Others*	All Bkgs	S/B
Cut 0	11.2	644.7	208.8	81.2	111.9	47.7	1387.8	54.5	49.3	621.1	3217.0	0.35%
Cut 1	10.6	577.7	157.6	58.8	92.4	32.6	1132.4	44.8	46.1	480.5	2622.9	0.40%
Cut 2	6.7	204.1	104.2	40.5	24.4	23.4	11.9	2.0	0.4	0.0	410.8	1.63%
Cut 3	5.1	157.3	53.3	20.1	18.4	10.8	9.9	1.6	0.3	0.0	270.8	1.88%

* ZX = ZW + ZZ
  HX = HW + HZ
  Others = WW, Drell-Yan and W+Jets

St/Δφ after Cut 3 (1μ+1e channel)





Analysis strategy (2e channel)

Process	Signal	ε signal (%)	P signal (%)	ttbar	ttW	WZ	S/B
Cut 0	3.8	10.3	59.1	451.9	75.6	814.0	0.28%
Cut 1	3.7	9.8	58.6	411.1	56.0	651.3	0.33%
Cut 2	2.3	5.5	60.3	136.6	36.4	7.2	1.28%
Cut 3	1.6	3.7	52.1	106.8	18.4	6.2	1.22%

$$\varepsilon = \frac{\text{Nb(Gen+Selection)}}{\text{Nb(Gen)}} \qquad P = \frac{\text{Nb(Selection+Gen)}}{\text{Nb(Selection)}}$$

Gen = SS Leptons coming from W

Analysis strategy (2e channel)

Process	Signal	ttbar	ttW	ttZ	Single top (tW)	ttH	ZX*	WWW	HX*	WW	Others*	All Bkgs	S/B
Cut 0	3.8	451.1	75.6	48.0	67.2	15.9	890.3	19.4	19.4	57.4	4900.0	6545.2	0.06%
Cut 1	3.7	411.1	56.0	33.2	57.5	10.7	718.6	15.3	17.9	50.6	1991.3	3362.1	0.11%
Cut 2	2.3	136.6	36.4	22.7	14.5	7.5	7.8	1.0	0.1	0.2	0.0	226.8	1.01%
Cut 3	1.6	106.8	18.4	11.1	11.1	3.2	6.6	0.8	0.1	0.2	0.0	158.4	1.01%

* ZX = ZW + ZZ
  HX = HW + HZ
  Others = Drell-Yan and W+Jets

St/Δφ after Cut 3 (2e channel)