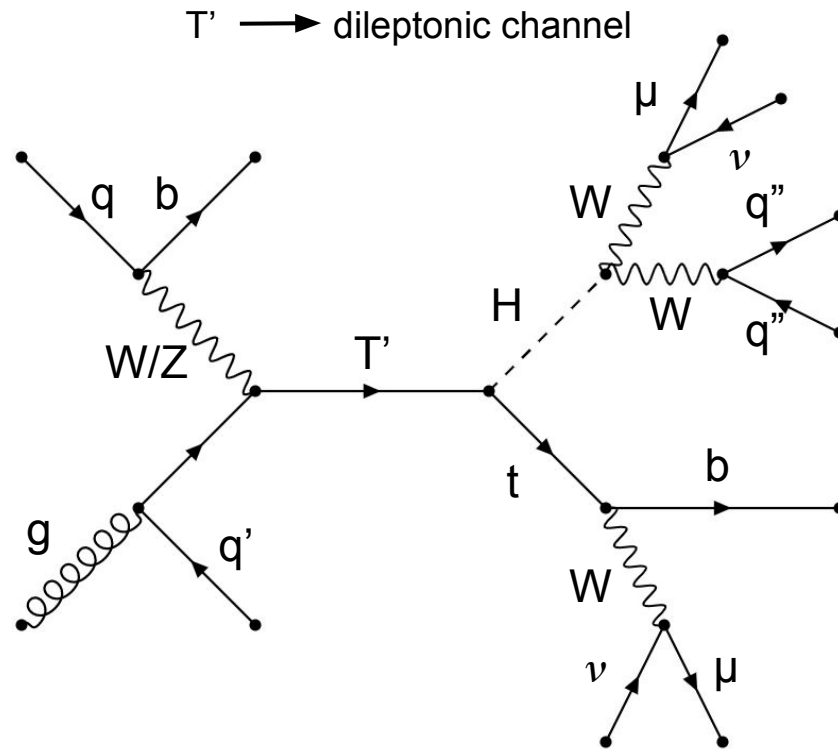


Software Review: Update

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Basic selection: 2 loose Muons with $P_t > 10$ GeV, $|\eta| < 2.4$ and loose isolation + 2 tight SS Muons with $P_t > 20$ GeV, $|\eta| < 2.4$, tight isolation and $\text{sip_3d} < 3$.

Identification of the electrons:
Initial test with the ttH AN selection.

List of the studied variables:

Electron_convVeto
Electron_cutBased
Electron_cutBased_HEEP
Electron_deltaEtaSC
Electron_dr03EcalRecHitSumEt
Electron_dr03HcalDepth1TowerSumEt
Electron_dr03TkSumPt
Electron_dr03TkSumPtHEEP
Electron_dxy
Electron_dz
Electron_eInvMinusPInv
Electron_eta

Electron_hoe
Electron_lostHits
Electron_miniPFRelIso_all
Electron_miniPFRelIso_chg
Electron_mvaFall17V2Iso_WP80
Electron_mvaFall17V2Iso_WPL
Electron_mvaTTH
Electron_pfRelIso03_all
Electron_pfRelIso03_chg
Electron_sieie
Electron_sip3d
Electron_vidNestedWPBitmapHEEP

Three final selections compared with the main backgrounds of the dimuon channel ($t\bar{t}b\bar{b}$, $t\bar{t}W$, WZ):

Study 1: $t\bar{t}H$ AN = loose ID, $P_t > 25$ GeV, $|\eta| < 2.5$, $abs(Electron_dxy) < 0.05$, $abs(Electron_dz) < 0.1$, $Electron_sip3d < 8$, $Electron_miniPFRellso_all < 0.40$, $Electron_sieie < 0.011$ for $(abs(Electron_eta) < 1.479)$ and $Electron_sieie < 0.03$ for $(abs(Electron_eta) > 1.479)$, $Electron_hoe < 0.1$, $Electron_elnvMinusPInv > -0.04$, $Electron_convVeto$ true, $Electron_lostHits == 0$ and $Electron_mvaFall17V2Iso_WPL$ true.

Study 2: tight ID, $P_t > 25$ GeV, $|\eta| < 2.5$, $Electron_sip3d < 3$ and $Electron_miniPFRellso_all < 0.05$ (same as the muons).

Study 3: $Electron_cutBased_HEEP$ true, $P_t > 25$ GeV, $|\eta| < 2.5$, $Electron_sip3d < 3$ and $Electron_miniPFRellso_all < 0.05$.

Definitions:

Efficiency = $Nb(\text{Gen} + \text{Selection}) / Nb(\text{Gen})$ where Gen=leptons coming from W.

Purity = $Nb(\text{Selection} + \text{Gen}) / Nb(\text{Selection})$ where Gen=leptons coming from W.

Strategy 1

	Study 1						Study 2						Study 3					
	Number of events		Efficiency (%)		Purity (%)		Number of events		Efficiency (%)		Purity (%)		Number of events		Efficiency (%)		Purity (%)	
	Total	1μ+ 1e	2μ	1μ+ 1e	2μ	1μ+ 1e	Total	1μ+ 1e	2μ	1μ+ 1e	2μ	1μ+ 1e	Total	1μ+ 1e	2μ	1μ+ 1e	2μ	1μ+ 1e
Signal	7.4	0.9	22.4	1.8	75.3	84.5	13.6	7.2	22.4	11.9	75.2	66.4	14.1	7.7	22.4	12.5	75.4	68.9
ttbar	194.6	167.4	-		-		451.7	430.3	-		-		638.3	615.9	-		-	
ttW	67.8	7.7	-		-		136.4	80.9	-		-		142.4	86.6	-		-	
WZ	52.5	16.9	-		-		182.7	147.1	-		-		198.4	162.8	-		-	
S/B	2.35%						1.76%						1.44%					

Strategy 2

	Study 1						Study 2						Study 3					
	Number of events		Efficiency (%)		Purity (%)		Number of events		Efficiency (%)		Purity (%)		Number of events		Efficiency (%)		Purity (%)	
	Total	1μ+ 1e	2μ	1μ+ 1e	2μ	1μ+ 1e	Total	1μ+ 1e	2μ	1μ+ 1e	2μ	1μ+ 1e	Total	1μ+ 1e	2μ	1μ+ 1e	2μ	1μ+ 1e
Signal	7.0	0.8	20.6	1.7	73.9	79.2	12.5	6.5	20.6	11.4	74.0	71.4	12.7	6.6	20.6	11.4	74.0	71.5
ttbar	146.1	123.7	-		-		379.6	367.7	-		-		504.5	486.3	-		-	
ttW	63.4	7.1	-		-		126.5	74.6	-		-		128.5	76.4	-		-	
WZ	48.4	14.5	-		-		162.8	128.8	-		-		169.5	135.6	-		-	
S/B	2.71%						1.87%						1.58%					

The efficiency for study 1 is too low for the e+ μ channel. ttbar becomes the main background but is too large for study 3 (the S/B decreases). → Study 2!

Update for the Cut with the jets: at least one b-jet (b-tag loose) of $P_t > 50$ GeV.
 → **At least 3 jets with** at least one b-jet (b-tag **medium**) of $P_t > 50$ GeV.

	Strategy 1						Strategy 2					
	Number of events		Efficiency (%)		Purity (%)		Number of events		Efficiency (%)		Purity (%)	
	Total	1μ+1e	2μ	1μ+1e	2μ	1μ+1e	Total	1μ+1e	2μ	1μ+1e	2μ	1μ+1e
Signal	9.8	5.6	16.0	9.8	77.4	68.7	8.9	4.8	14.6	9.0	74.4	74.3
ttbar	192.9	183.8	-		-		162.6	154.1	-		-	
ttW	92.0	54.1	-		-		86.3	50.5	-		-	
WZ	10.8	8.3	-		-		10.8	8.5	-		-	
S/B	3.31%						3.43%					

The WZ has been almost completely removed and the S/B is the highest for the Strategy 2.

Current analysis:

Identification of the muons: loose = loose ID, $P_t > 20 \text{ GeV}$, $|\eta| < 2.4$ and $\text{Muon_miniPFRellso_all} < 0.40$.

tight = loose Muon + tight ID, $P_t > 20 \text{ GeV}$, $|\eta| < 2.4$, $\text{Muon_sip3d} < 3$ and $\text{Muon_miniPFRellso_all} < 0.05$.

Identification of the electrons: tight ID, $P_t > 25 \text{ GeV}$, $|\eta| < 2.5$, $\text{Electron_sip3d} < 3$ and $\text{Electron_miniPFRellso_all} < 0.05$.

Cut 0: 2 Leptons SS with Sum of P_t of the two leptons $> 160 \text{ GeV}$.

Cut 1: ΔR between the two leptons > 1.8 .

Cut 2: at least 3 jets with at least one b-jet (b-tag medium) of $P_t > 50 \text{ GeV}$.

Cut 3: minimum of the invariant mass of the three jets with a least one b-jet $> 34 \text{ GeV}$ (Mass of the top $\pm 2\sigma$).

Try to remove the $t\bar{t}$, add the dielectron channel, switch to the official datasets to remove duplicated events.