

mono-Higgs (bb) updates

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UW Madison

April 5, 2023

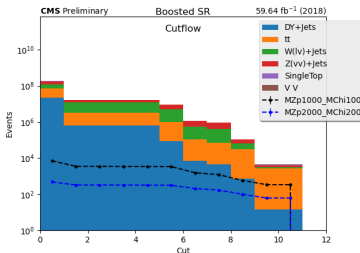
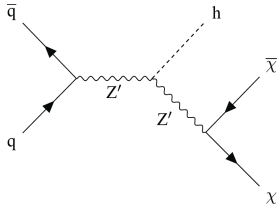
Updates: April 6

- Produced 2017 plots.
Next slides show SR and CRs cutflow for both categories for 2017 & 2018.
- Slides 15-18 show FatJet and DiJet mass.
Other kinematic plots added to gitlab repo. ([link:2017](#) and [link:2018](#))
- Looking into Combine documentation.

Boosted Category Signal Region: 2018

$\text{Mass}[Z', \chi] = [1000, 100], [2000, 200] \text{ GeV}$

$\sigma = 0.2077\text{pb} \times \text{BR}, 0.01413\text{pb} \times \text{BR}$, where $\text{BR}(H \rightarrow b\bar{b})=0.582$



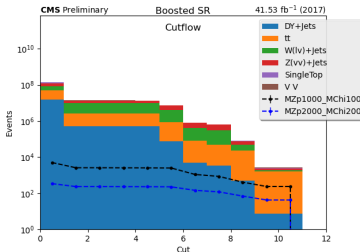
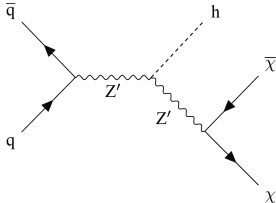
Bin	Selection	Total Bkg	Signal1	Signal2	$S1/\sqrt{S1+B}$	$S2/\sqrt{S2+B}$
0	NoCut	1.95e+08	7117.13	484.18	0.51	0.03
1	MET-Trigger	1.70e+07	3514.42	327.06	0.85	0.08
2	MET-Filter	1.70e+07	3514.42	327.06	0.85	0.08
3	$N_\tau = 0$	1.70e+07	3475.78	323.98	0.84	0.08
4	$N_\gamma = 0$	1.69e+07	3452.42	321.25	0.84	0.08
5	$N_{e/\mu} = 0$	9.22e+06	3405.59	317.07	1.12	0.10
6	$p_T^{\text{miss}} > 250\text{GeV}$	1.16e+06	1555.99	207.11	1.44	0.19
7	$N(\text{FatJet})=1$	9.12e+05	1216.82	171.05	1.27	0.18
8	$70 < M_{\text{softdrop}} < 150\text{GeV}$	1.13e+05	582.49	99.94	1.73	0.30
9	SubJet_btag	4.51e+03	340.04	62.12	4.88	0.92
10	$\Delta\phi(\text{met}, FJ) > 0.8$	4.50e+03	340.03	62.11	4.89	0.92

FatJet selections: $p_T > 200$, $|\eta| < 2.5$, tight jetId, $\Delta R(e/\mu, \text{FatJet}) > 0.8$

Boosted Category Signal Region: 2017

$\text{Mass}[Z', \chi] = [1000, 100], [2000, 200] \text{ GeV}$

$\sigma = 0.2077\text{pb} \times \text{BR}, 0.01413\text{pb} \times \text{BR}$, where $\text{BR}(H \rightarrow b\bar{b})=0.582$



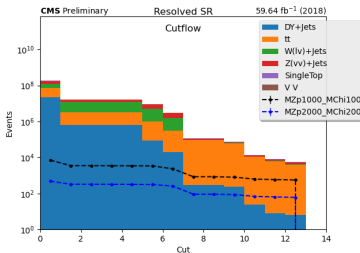
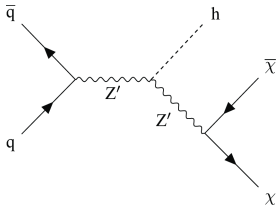
Bin	Selection	Total Bkg	Signal1	Signal2	$S1/\sqrt{S1+B}$	$S2/\sqrt{S2+B}$
0	NoCut	1.41e+08	5020.08	341.52	0.42	0.03
1	MET-Trigger	1.38e+07	2587.35	234.91	0.70	0.06
2	MET-Filter	1.38e+07	2587.35	234.91	0.70	0.06
3	$N_\tau = 0$	1.38e+07	2560.19	232.68	0.69	0.06
4	$N_\gamma = 0$	1.37e+07	2542.47	230.71	0.69	0.06
5	$N_{e/\mu} = 0$	7.43e+06	2501.75	227.38	0.92	0.08
6	$p_T^{\text{miss}} > 250\text{GeV}$	8.29e+05	1102.07	145.32	1.21	0.16
7	$N(\text{FatJet})=1$	6.54e+05	859.78	119.85	1.06	0.15
8	$70 < M_{\text{softdrop}} < 150\text{GeV}$	8.32e+04	412.83	70.00	1.43	0.24
9	SubJet_btag	2.70e+03	237.58	42.53	4.38	0.81
10	$\Delta\phi(\text{met}, FJ) > 0.8$	2.70e+03	237.58	42.53	4.38	0.81

FatJet selections: $p_T > 200$, $|\eta| < 2.5$, tight jetId, $\Delta R(e/\mu, \text{FatJet}) > 0.8$

Resolved category Signal Region: 2018

$\text{Mass}[Z', \chi] = [1000, 100], [2000, 200] \text{ GeV}$

$\sigma = 0.2077\text{pb} \times \text{BR}, 0.01413\text{pb} \times \text{BR}$, where $\text{BR}(H \rightarrow b\bar{b})=0.582$

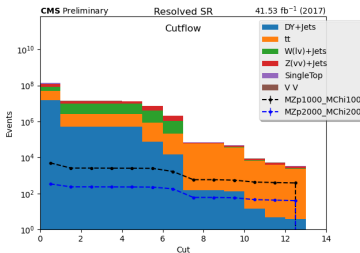
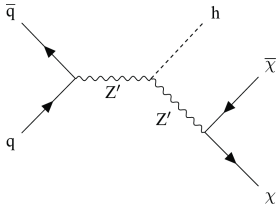


Bin	Selection	Total Bkg	Signal1	Signal2	$S1/\sqrt{S1+B}$	$S2/\sqrt{S2+B}$
0	NoCut	1.95e+08	7117.13	484.18	0.51	0.03
1	MET-Trigger	1.70e+07	3514.42	327.06	0.85	0.08
2	MET-Filter	1.70e+07	3514.42	327.06	0.85	0.08
3	$N_T = 0$	1.70e+07	3475.78	323.98	0.84	0.08
4	$N_\gamma = 0$	1.69e+07	3452.42	321.25	0.84	0.08
5	$N_{e/\mu} = 0$	9.22e+06	3405.59	317.07	1.12	0.10
6	$p_T^{\text{miss}} > 200\text{GeV}$	3.01e+06	2354.90	259.16	1.36	0.15
7	$p_T(b_1) > 50\text{GeV}$	1.14e+05	857.17	91.18	2.52	0.27
8	$p_T(b_2) > 30\text{GeV}$	1.14e+05	857.17	91.18	2.52	0.27
9	$p_T(b_1 b_2) > 100\text{GeV}$	7.78e+04	808.17	87.57	2.88	0.31
10	$100 < M(b_1 b_2) < 150\text{GeV}$	1.37e+04	629.90	69.22	5.26	0.59
11	$\Delta\phi(\text{met}, \text{ak4j}) > 0.4$	8.29e+03	592.85	64.87	6.29	0.71
12	$N_{\text{ajet}} \leq 2$	5.66e+03	562.73	60.87	7.13	0.80

Resolved category Signal Region: 2017

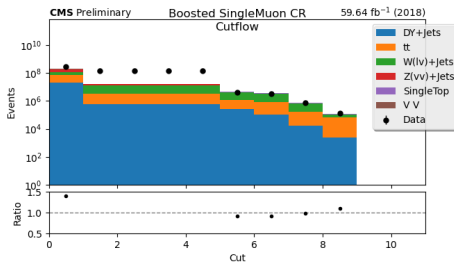
$\text{Mass}[Z', \chi] = [1000, 100], [2000, 200] \text{ GeV}$

$\sigma = 0.2077\text{pb} \times \text{BR}, 0.01413\text{pb} \times \text{BR}$, where $\text{BR}(H \rightarrow b\bar{b})=0.582$



Bin	Selection	Total Bkg	Signal1	Signal2	$S1/\sqrt{S1+B}$	$S2/\sqrt{S2+B}$
0	NoCut	1.41e+08	5020.08	341.52	0.42	0.03
1	MET-Trigger	1.38e+07	2587.35	234.91	0.70	0.06
2	MET-Filter	1.38e+07	2587.35	234.91	0.70	0.06
3	$N_T = 0$	1.38e+07	2560.19	232.68	0.69	0.06
4	$N_\gamma = 0$	1.37e+07	2542.47	230.71	0.69	0.06
5	$N_{e/\mu} = 0$	7.43e+06	2501.75	227.38	0.92	0.08
6	$p_T^{\text{miss}} > 200\text{GeV}$	2.16e+06	1674.35	182.15	1.14	0.12
7	$p_T(b_1) > 50\text{GeV}$	7.23e+04	587.94	60.70	2.18	0.23
8	$p_T(b_2) > 30\text{GeV}$	7.23e+04	587.94	60.70	2.18	0.23
9	$p_T(b_1 b_2) > 100\text{GeV}$	4.84e+04	553.15	58.21	2.50	0.26
10	$100 < M(b_1 b_2) < 150\text{GeV}$	8.57e+03	431.91	45.90	4.55	0.49
11	$\Delta\phi(\text{met}, \text{ak4j}) > 0.4$	5.17e+03	406.31	42.95	5.44	0.60
12	$N_{\text{ajet}} \leq 2$	3.51e+03	386.37	40.25	6.19	0.68

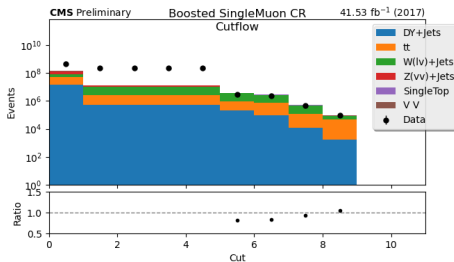
Boosted category SingleMuon CR: 2018



Bin	Selection	N(data)	N(mc)	Ratio(data/mc)
0	NoCut	2.74e+08	1.95e+08	1.404
1	MET-Trigger	1.50e+08	1.70e+07	8.837
2	MET-Filter	1.50e+08	1.70e+07	8.837
3	$N_{\tau} = 0$	1.50e+08	1.70e+07	8.837
4	$N_{\gamma} = 0$	1.50e+08	1.69e+07	8.861
5	$N_{\mu} = 1$	4.19e+06	4.58e+06	0.913
6	$p_T^{miss} > 50\text{GeV}$	3.30e+06	3.58e+06	0.922
7	Recoil > 250GeV	7.26e+05	7.38e+05	0.984
8	N(FatJet)=1	1.35e+05	1.22e+05	1.103

FatJet selections: $p_T > 200$, $|\eta| < 2.5$, $70 < M_{sd} < 150$,
tight jetId, $\Delta R(e/\mu, \text{FatJet}) > 0.8$

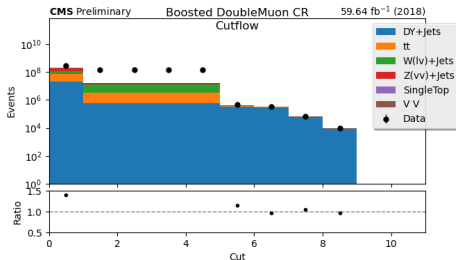
Boosted category SingleMuon CR: 2017



Bin	Selection	N(data)	N(mc)	Ratio(data/mc)
0	NoCut	4.37e+08	1.41e+08	3.088
1	MET-Trigger	2.31e+08	1.38e+07	16.766
2	MET-Filter	2.31e+08	1.38e+07	16.766
3	$N_{\tau} = 0$	2.31e+08	1.38e+07	16.766
4	$N_{\gamma} = 0$	2.30e+08	1.37e+07	16.851
5	$N_{\mu} = 1$	3.08e+06	3.72e+06	0.828
6	$p_T^{miss} > 50\text{GeV}$	2.41e+06	2.86e+06	0.840
7	Recoil > 250GeV	4.95e+05	5.29e+05	0.936
8	N(FatJet)=1	9.53e+04	9.03e+04	1.055

FatJet selections: $p_T > 200$, $|\eta| < 2.5$, $70 < M_{sd} < 150$,
tight jetId, $\Delta R(e/\mu, \text{FatJet}) > 0.8$

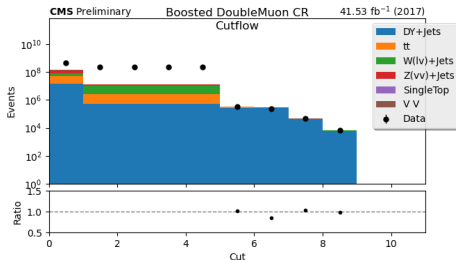
Boosted category DoubleMuon CR: 2018



Bin	Selection	N(data)	N(mc)	Ratio(data/mc)
0	NoCut	2.74e+08	1.95e+08	1.404
1	MET-Trigger	1.50e+08	1.70e+07	8.837
2	MET-Filter	1.50e+08	1.70e+07	8.837
3	$N_{\tau} = 0$	1.50e+08	1.70e+07	8.837
4	$N_{\gamma} = 0$	1.50e+08	1.69e+07	8.861
5	$N_{\mu} = 2$	4.68e+05	4.08e+05	1.147
6	$60 < M(\mu\mu) < 120\text{GeV}$	3.32e+05	3.45e+05	0.962
7	Recoil > 250GeV	6.96e+04	6.57e+04	1.059
8	N(FatJet)=1	9.40e+03	9.70e+03	0.969

FatJet selections: $p_T > 200$, $|\eta| < 2.5$, $70 < M_{sd} < 150$,
tight jetId, $\Delta R(e/\mu, \text{FatJet}) > 0.8$

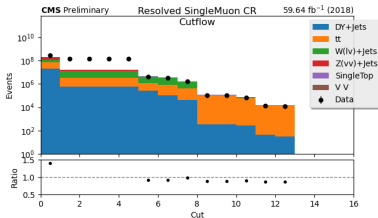
Boosted category DoubleMuon CR: 2017



Bin	Selection	N(data)	N(mc)	Ratio(data/mc)
0	NoCut	4.37e+08	1.41e+08	3.088
1	MET-Trigger	2.31e+08	1.38e+07	16.766
2	MET-Filter	2.31e+08	1.38e+07	16.766
3	$N_{\tau} = 0$	2.31e+08	1.38e+07	16.766
4	$N_{\gamma} = 0$	2.30e+08	1.37e+07	16.851
5	$N_{\mu} = 2$	3.45e+05	3.38e+05	1.021
6	$60 < M(\mu\mu) < 120\text{GeV}$	2.45e+05	2.86e+05	0.857
7	Recoil > 250GeV	4.82e+04	4.63e+04	1.041
8	N(FatJet)=1	6.83e+03	6.96e+03	0.981

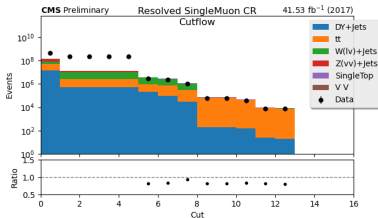
FatJet selections: $p_T > 200$, $|\eta| < 2.5$, $70 < M_{sd} < 150$,
tight jetId, $\Delta R(e/\mu, \text{FatJet}) > 0.8$

Resolved category Single Muon CR: 2018



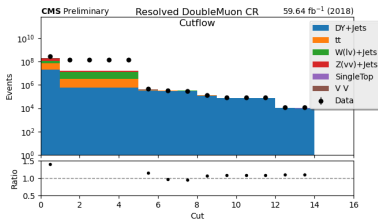
Bin	Selection	Data	MC background	Ratio (data/mc)
0	NoCut	2.74e+08	1.95e+08	1.404
1	MET-Trigger	1.50e+08	1.70e+07	8.837
2	MET-Filter	1.50e+08	1.70e+07	8.837
3	$N_{\tau} = 0$	1.50e+08	1.70e+07	8.837
4	$N_{\gamma} = 0$	1.50e+08	1.69e+07	8.861
5	$N_{\mu} = 1$	4.19e+06	4.58e+06	0.913
6	$p_T^{\text{miss}} > 50\text{GeV}$	3.30e+06	3.58e+06	0.922
7	Recoil > 200GeV	1.59e+06	1.62e+06	0.985
8	$p_T(b_1) > 50\text{GeV}$	1.05e+05	1.18e+05	0.887
9	$p_T(b_2) > 30\text{GeV}$	1.05e+05	1.18e+05	0.887
10	$p_T(b_1 b_2) > 100\text{GeV}$	6.77e+04	7.51e+04	0.901
11	$100 < M(b_1 b_2) < 150\text{GeV}$	1.36e+04	1.56e+04	0.875
12	$N_{\text{ajet}} \geq 1$	1.25e+04	1.44e+04	0.863

Resolved category Single Muon CR: 2017



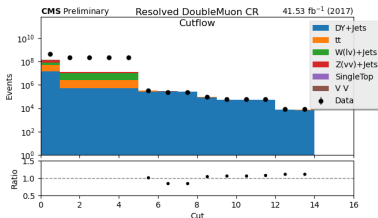
Bin	Selection	Data	MC background	Ratio (data/mc)
0	NoCut	4.37e+08	1.41e+08	3.088
1	MET-Trigger	2.31e+08	1.38e+07	16.766
2	MET-Filter	2.31e+08	1.38e+07	16.766
3	$N_{\tau} = 0$	2.31e+08	1.38e+07	16.766
4	$N_{\gamma} = 0$	2.30e+08	1.37e+07	16.851
5	$N_{\mu} = 1$	3.08e+06	3.72e+06	0.828
6	$p_T^{miss} > 50\text{GeV}$	2.41e+06	2.86e+06	0.840
7	$\text{Recoil} > 200\text{GeV}$	1.09e+06	1.17e+06	0.938
8	$p_T(b_1) > 50\text{GeV}$	6.24e+04	7.62e+04	0.819
9	$p_T(b_2) > 30\text{GeV}$	6.24e+04	7.62e+04	0.819
10	$p_T(b_1 b_2) > 100\text{GeV}$	3.97e+04	4.78e+04	0.831
11	$100 < M(b_1 b_2) < 150\text{GeV}$	7.86e+03	9.66e+03	0.814
12	$N_{\text{ajet}} \geq 1$	7.25e+03	8.97e+03	0.808

Resolved category Double Muon CR: 2018



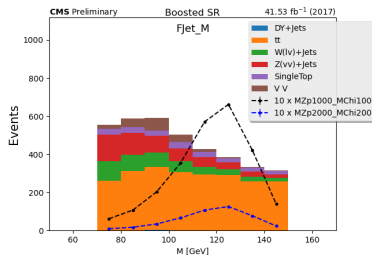
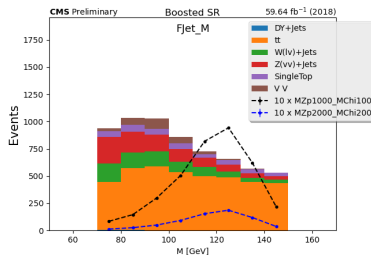
Bin	Selection	Data	MC background	Ratio (data/mc)
0	NoCut	2.74e+08	1.95e+08	1.404
1	MET-Trigger	1.50e+08	1.70e+07	8.837
2	MET-Filter	1.50e+08	1.70e+07	8.837
3	$N_{\tau} = 0$	1.50e+08	1.70e+07	8.837
4	$N_{\gamma} = 0$	1.50e+08	1.69e+07	8.861
5	$N_{\mu} = 2$	4.68e+05	4.08e+05	1.147
6	$60 < M(\mu\mu) < 120\text{GeV}$	3.32e+05	3.45e+05	0.962
7	$p_T^{\text{miss}} < 100\text{GeV}$	3.12e+05	3.25e+05	0.960
8	$\text{Recoil} > 200\text{GeV}$	1.40e+05	1.32e+05	1.065
9	$p_T(j_1) > 50\text{GeV}$	8.52e+04	7.89e+04	1.080
10	$p_T(j_2) > 30\text{GeV}$	8.52e+04	7.89e+04	1.080
11	$p_T(j_1 j_2) > 100\text{GeV}$	8.36e+04	7.74e+04	1.080
12	$100 < M(j_1 j_2) < 150\text{GeV}$	1.21e+04	1.09e+04	1.112
13	$N_{\text{ajet}} \leq 2$	1.18e+04	1.06e+04	1.109

Resolved category Double Muon CR: 2017

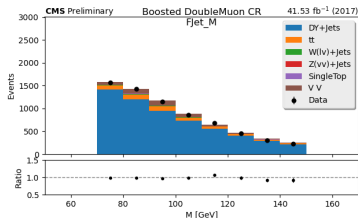
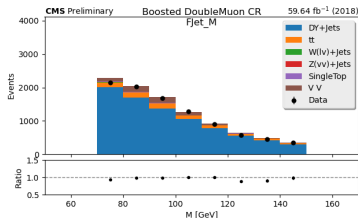
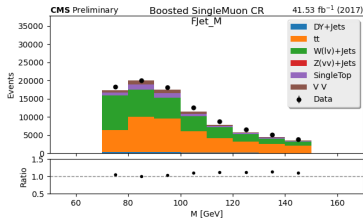
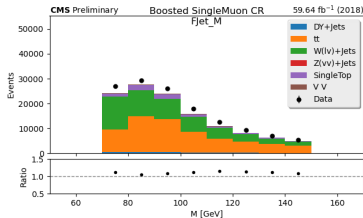


Bin	Selection	Data	MC background	Ratio (data/mc)
0	NoCut	4.37e+08	1.41e+08	3.088
1	MET-Trigger	2.31e+08	1.38e+07	16.766
2	MET-Filter	2.31e+08	1.38e+07	16.766
3	$N_{\tau} = 0$	2.31e+08	1.38e+07	16.766
4	$N_{\gamma} = 0$	2.30e+08	1.37e+07	16.851
5	$N_{\mu} = 2$	3.45e+05	3.38e+05	1.021
6	$60 < M(\mu\mu) < 120\text{GeV}$	2.45e+05	2.86e+05	0.857
7	$p_T^{\text{miss}} < 100\text{GeV}$	2.30e+05	2.69e+05	0.856
8	$\text{Recoil} > 200\text{GeV}$	9.88e+04	9.35e+04	1.057
9	$p_T(j_1) > 50\text{GeV}$	6.06e+04	5.62e+04	1.078
10	$p_T(j_2) > 30\text{GeV}$	6.06e+04	5.62e+04	1.078
11	$p_T(j_1 j_2) > 100\text{GeV}$	5.96e+04	5.51e+04	1.081
12	$100 < M(j_1 j_2) < 150\text{GeV}$	8.82e+03	7.84e+03	1.125
13	$N_{\text{ajet}} \leq 2$	8.55e+03	7.62e+03	1.123

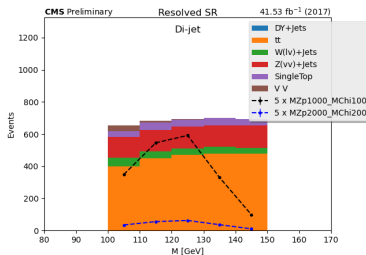
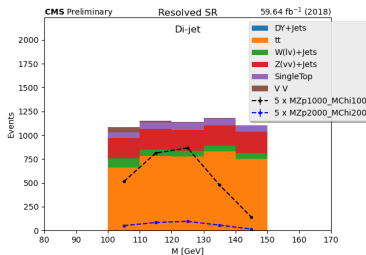
FatJet softdrop mass: SR



FatJet softdrop mass: 1μ and 2μ CRs



Di-jet mass: SR



Di-jet mass: 1μ and 2μ CRs

