Study of extra muons in $H \to WW$ candidate events in the $\mu\mu$ channal

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Content

- Properities of extra muons in dimuon candidate events are studied.
- Following a study done by Rikard, on only data candidate events, a MC/data comparison for 1 fb^1 of has been done.
- Are these extra muons modeled correctly by our MC and what is is there origin?
- Results are shown for $\mu\mu$ candidate events, passing the standard selection. Results are divided in 0 and 1 jet candidates.

How I count extra muons:

- Selected muons are identified using smallest ΔR and the requirement, that they have to be staco combined.
- Identified muons are removed from the extra muon counting and all others that have a $\Delta R < 0.1$ with an identified muon as well.
- Overlap between all other extra muons is removed requirering $\Delta R < 0.1$.

extra muons in data

0 jet candidates

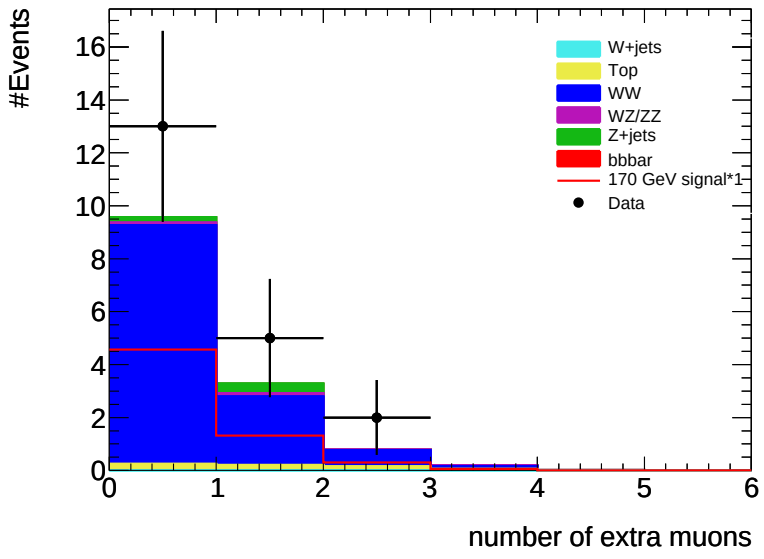
event number	author	d_0^{sig}	z_0	p_T	η	etcone	ptcone	etcone/pt	ptcone/pt
65690511	11	-0.318678	-538.247	1.13534	2.51458	0	0	0	0
2400321	18	-1.85038	-65.7776	3.30437	1.22003	0.409651	0	0.123973	0
74091938	16	0.00914778	-0.0865216	51.502	0.0106663	0.054821	0	0.00106444	0
55903451	16	0.206022	-0.000290241	5.62393	0.71978	1.17535	0	0.208991	0
55903451	17	0.658047	-11.3348	4.21339	-1.76395	0.146701	0	0.0348179	0
118523855	16	1.48509	67.7141	2.17962	0.870965	-0.129866	1.00034	-0.059582	0.458952
51783353	16	-0.696798	-0.120615	2.09421	2.01966	0.0883693	0	0.042197	0
51783353	16	-0.445796	113.721	2.65926	1.7085	0.329781	1.86033	0.124012	0.699566
26617119	6	-0.107601	-855.794	0.798508	2.81558	0.406418	0	0.508972	0

1 jet candidates

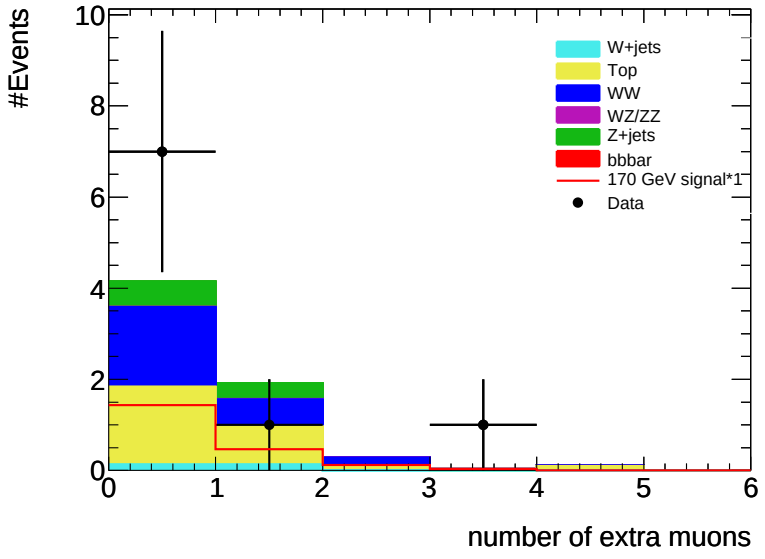
event number	author	d_0^{sig}	z_0	p_T	η	etcone	ptcone	etcone/pt	ptcone/pt
54709073	11	0.00178515	-80.3357	16.2648	1.64078	0.216637	0	0.0133194	0
54709073	12	-16.8952	-0.145107	9.52061	-0.0105866	8.28287	3.59213	0.869993	0.3773
54709073	13	-0.274781	-94.0696	1.55428	1.9084	-0.0284427	0	-0.0182995	0
2013594	12	0.58777	0.269367	11.4189	-0.634679	14.247	16.6622	1.24767	1.45918

number of extra muons in candidate events

0 jet candidates



1 jet candidates

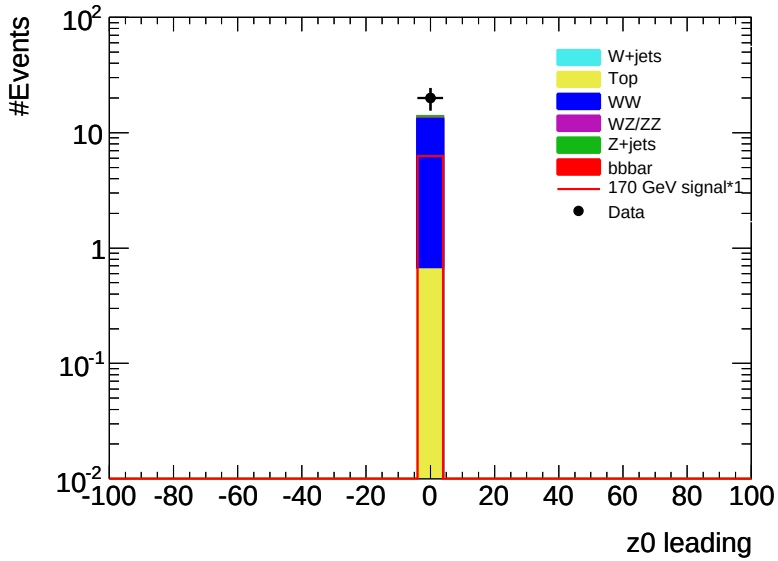


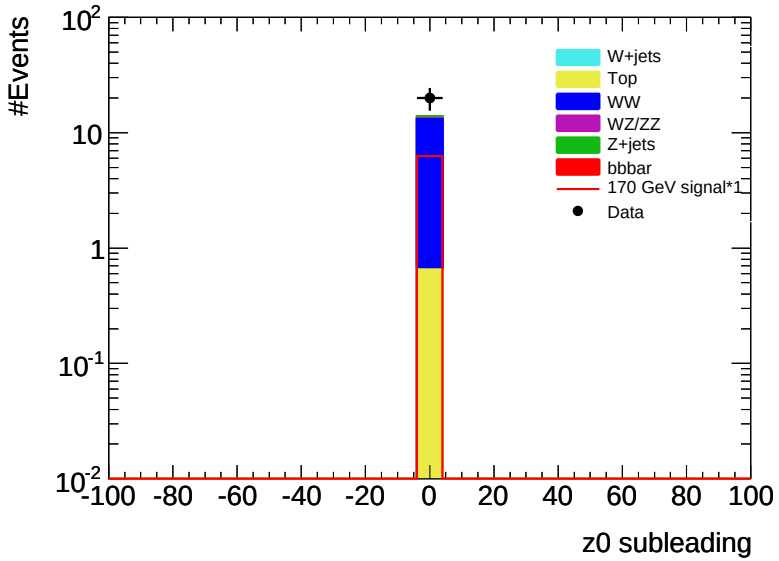
20 candidates:
5 events with 1 extra muon.
2 event with 2 extra muons.

9 candidate events:
1 event with one extra muon.
1 event with three extra muons.

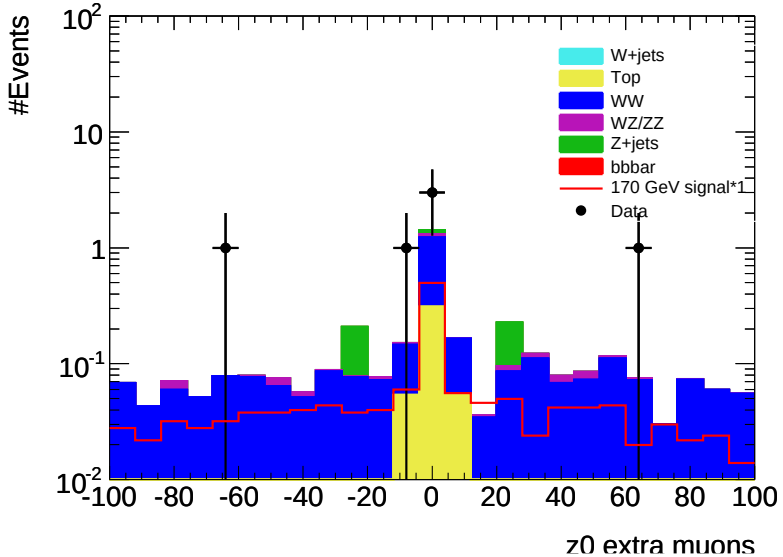
0 jet candidates

longitudinal impact parameter z_0

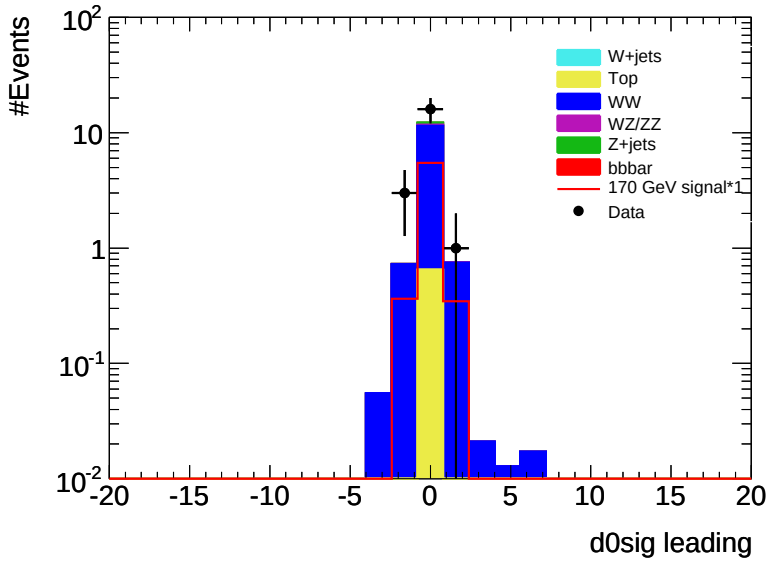


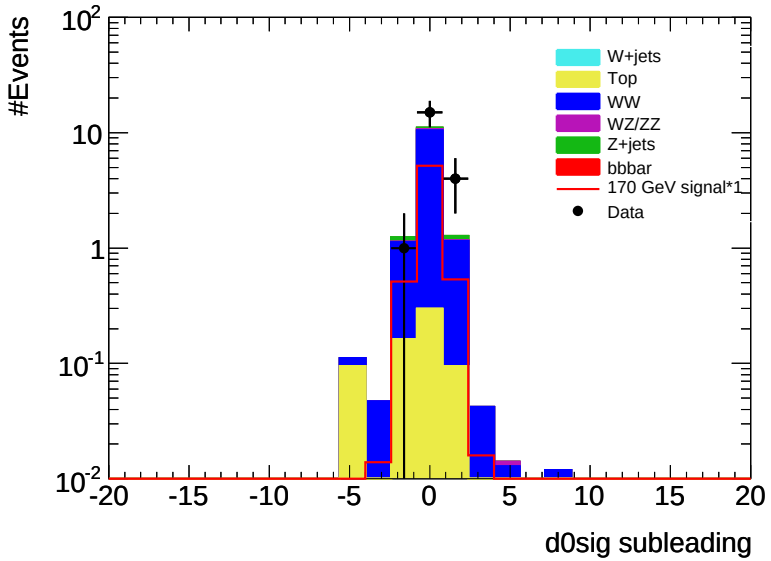


extra muons originating from displaced primary vertex
$\rightarrow$ pile up

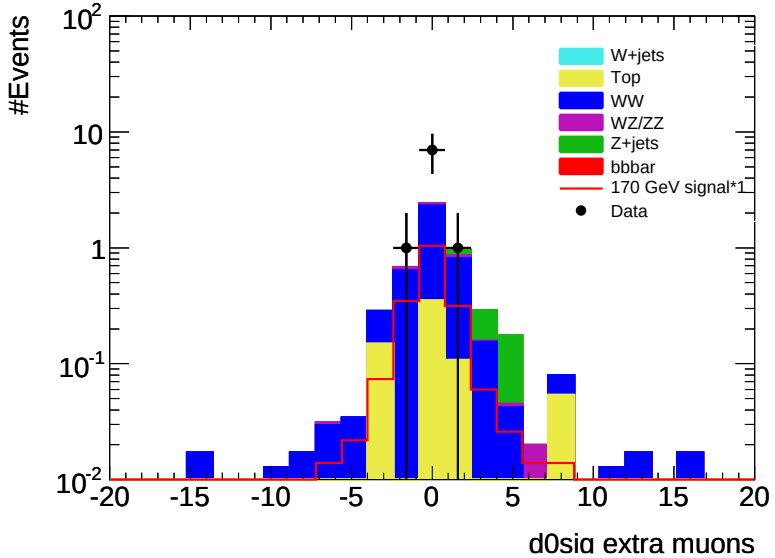


transverse impact parameter significance d_0^{sig}

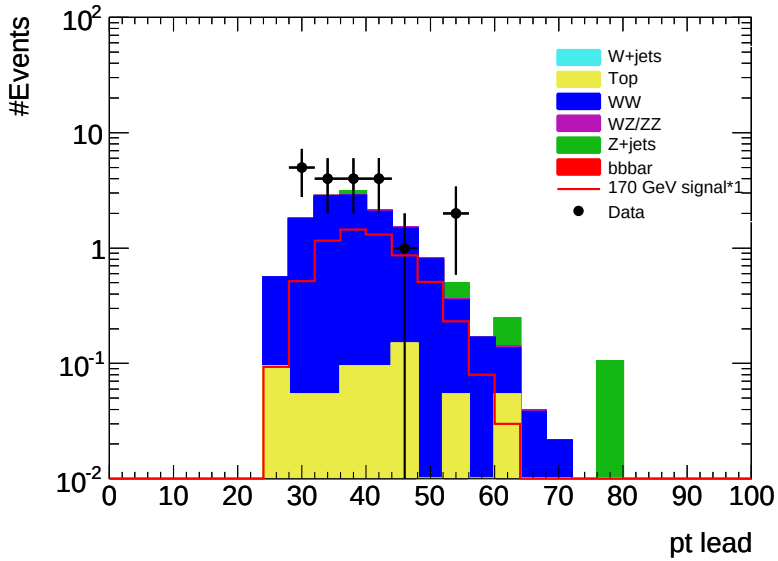


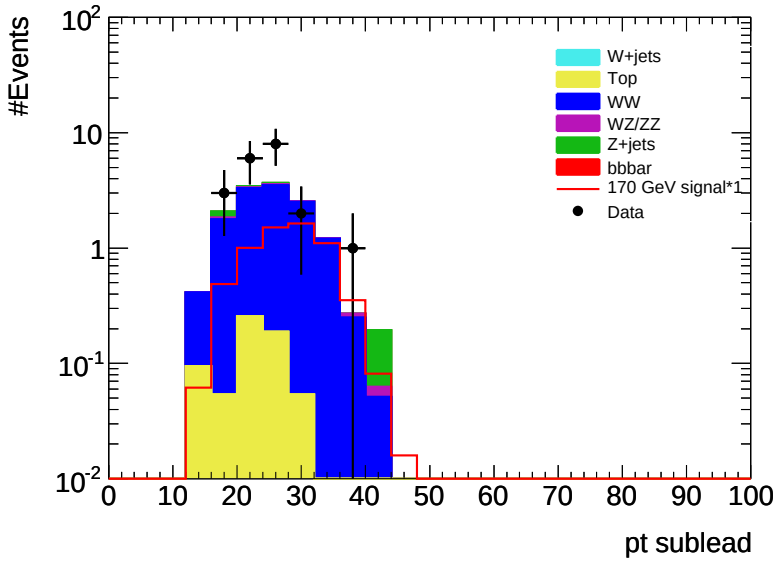


No extra muons expected and observed originating from a secondary decay vertex. (Not quite sure about that conclusion)

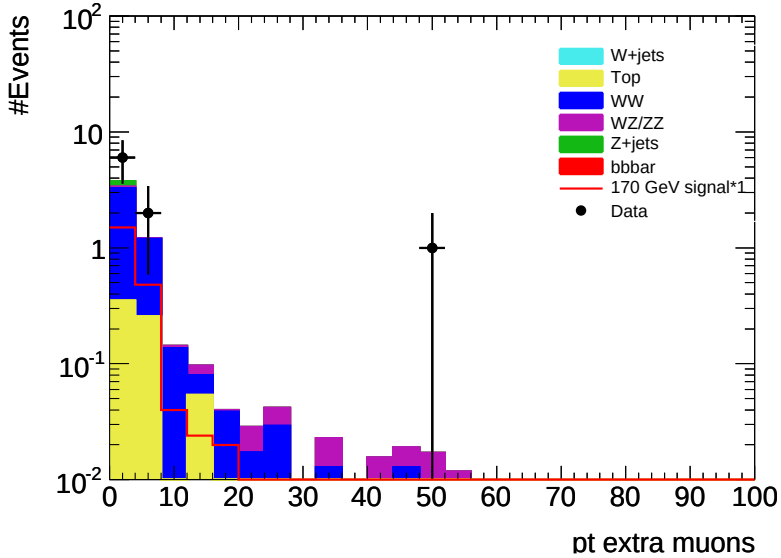


transverse momentum p_T

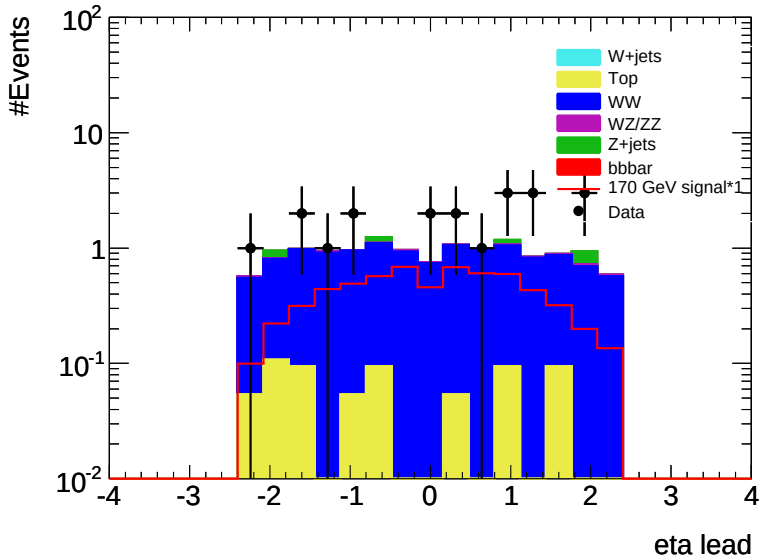


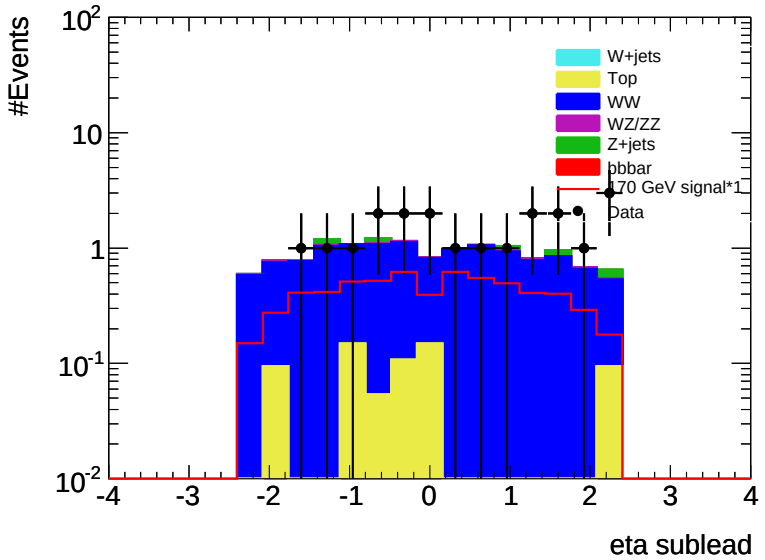


Most extra muons have very low p_T.
One extra muon with p_T 50 GeV.
Could be WZ/ZZ. (Need to check why it didnt pass the selection)

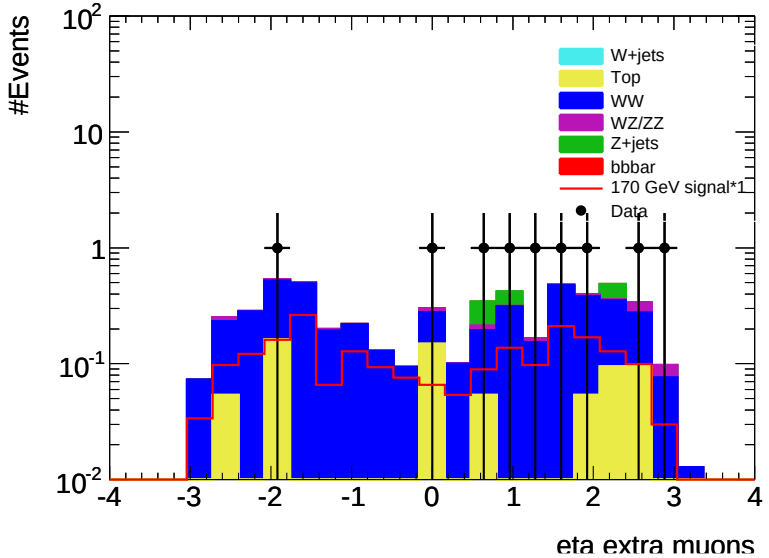


η

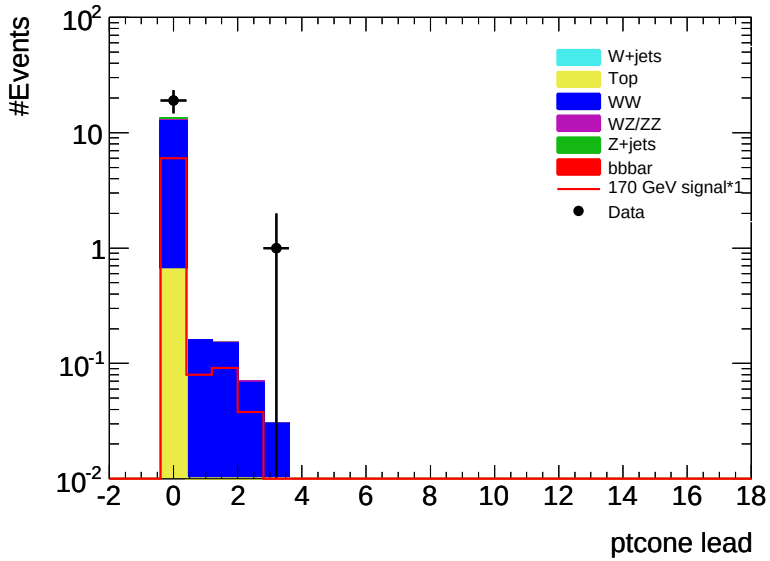


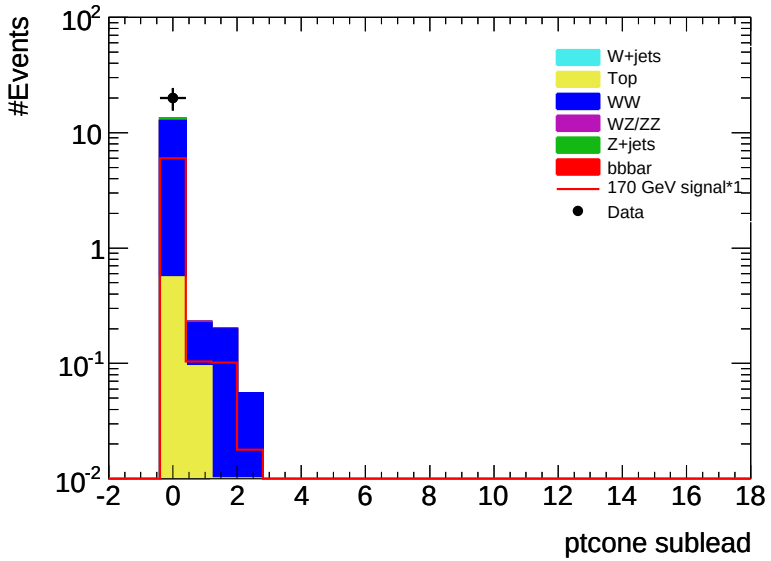


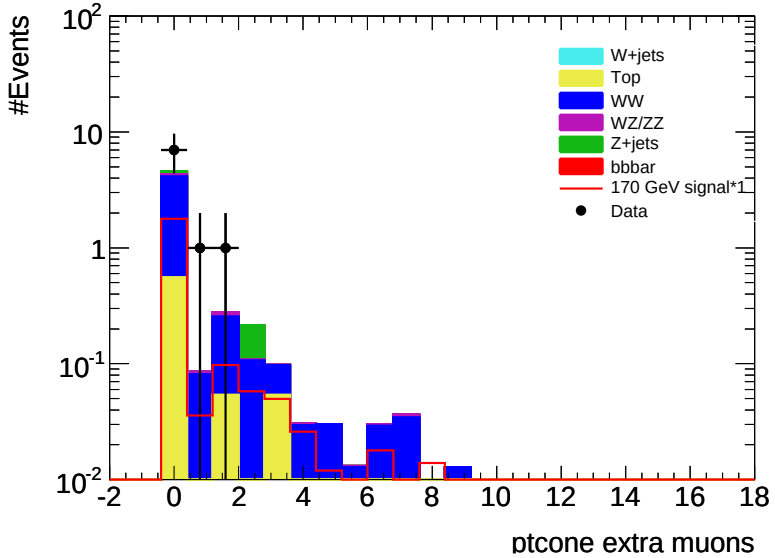
Seems to be more extra muons in positive eta.(Would there be a reason?)



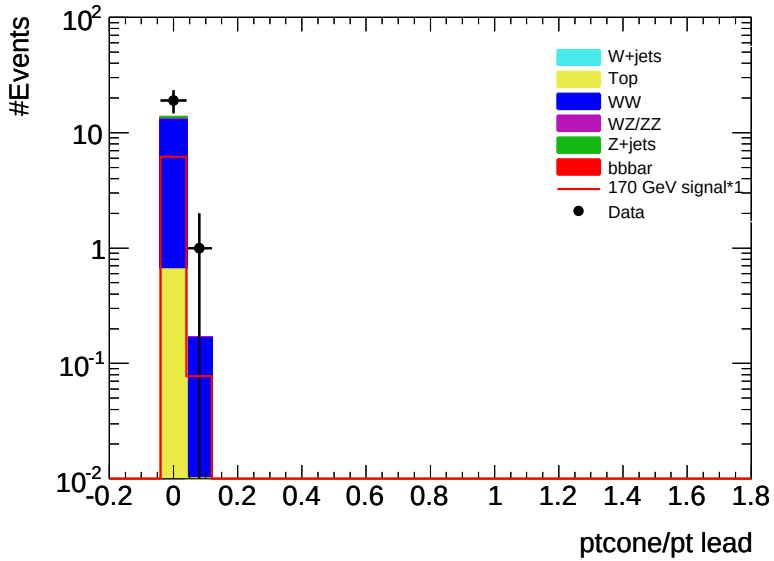
track isolation ptcone

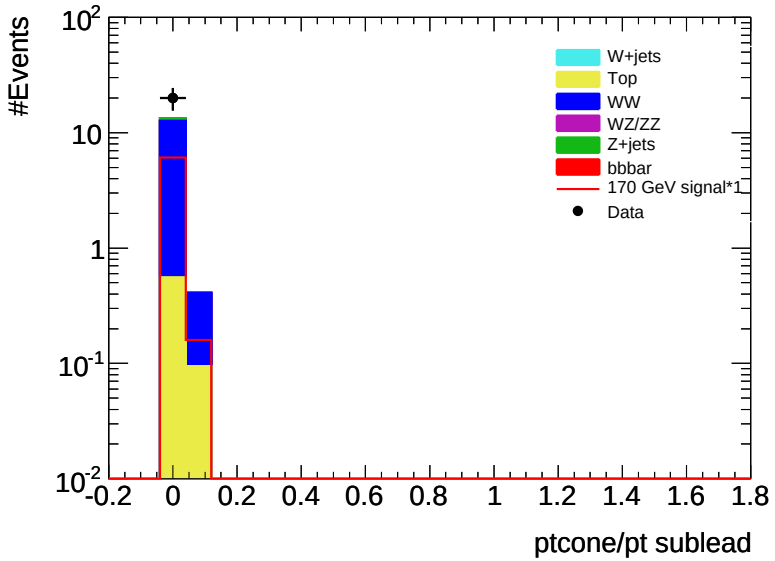




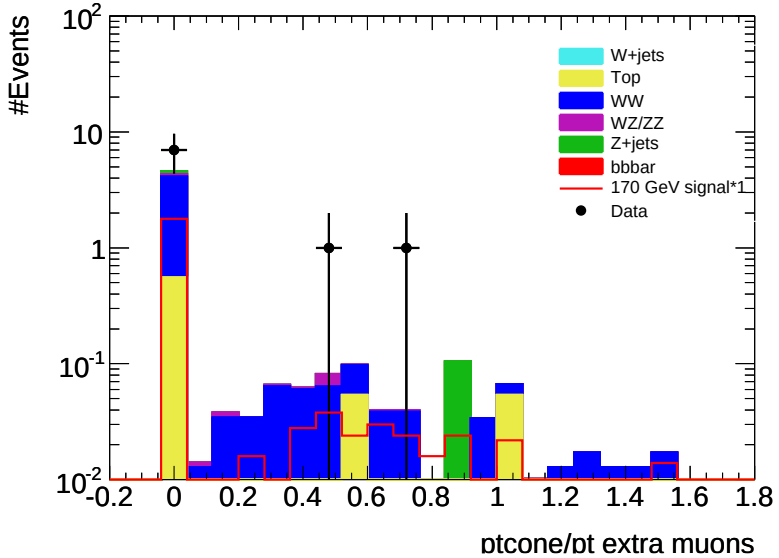


normalized track isolation ptcone/pt

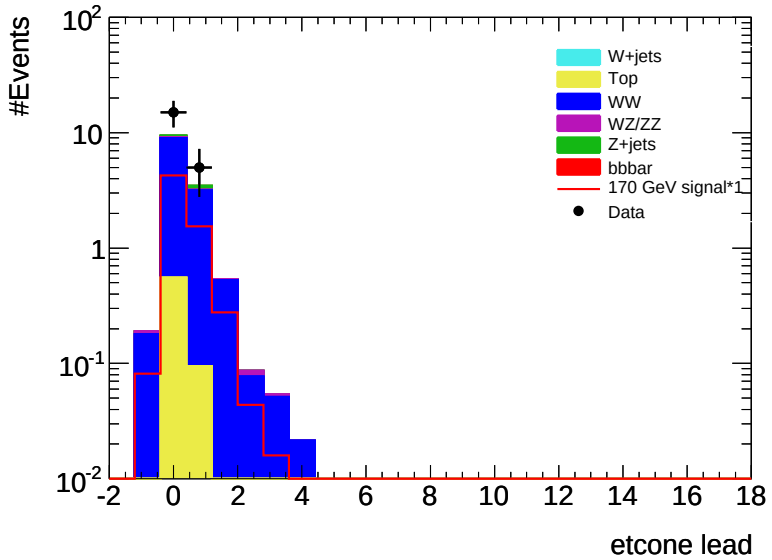


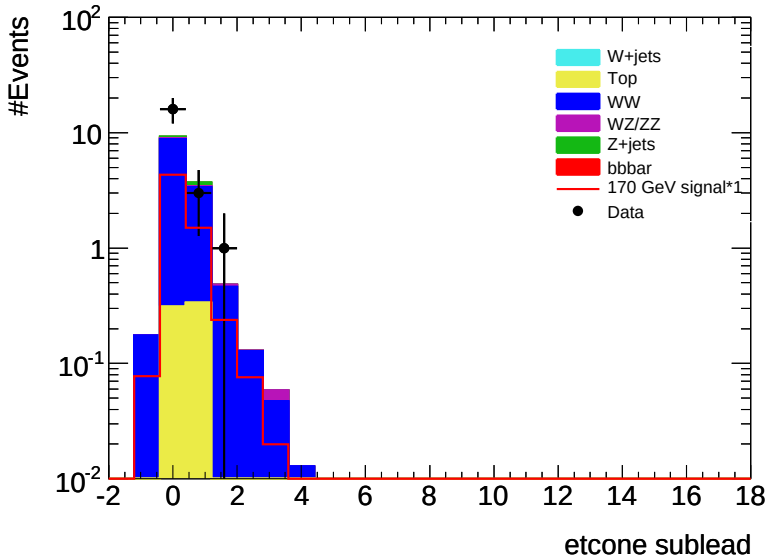


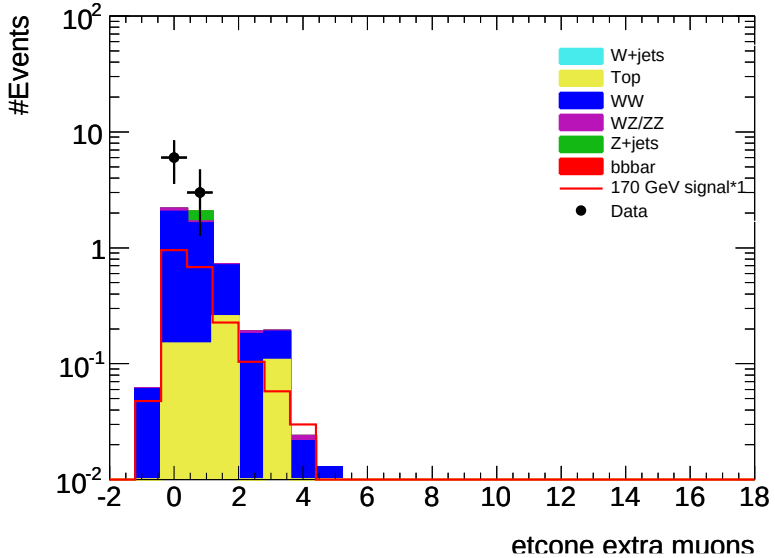
Two of nine extra muons have an isolated track.



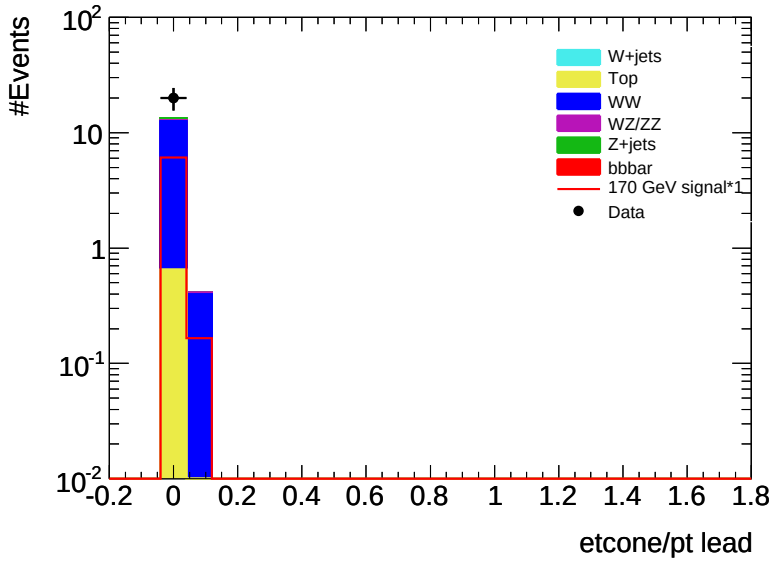
calorimeter isolation etcone

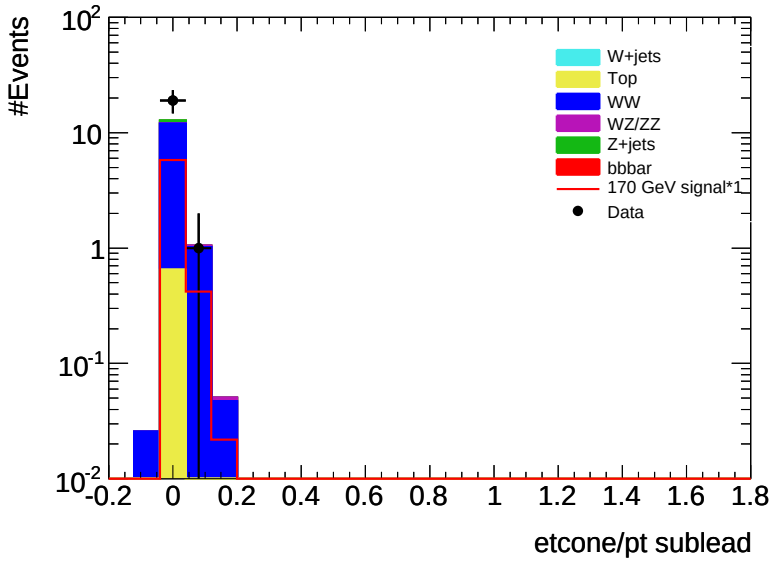




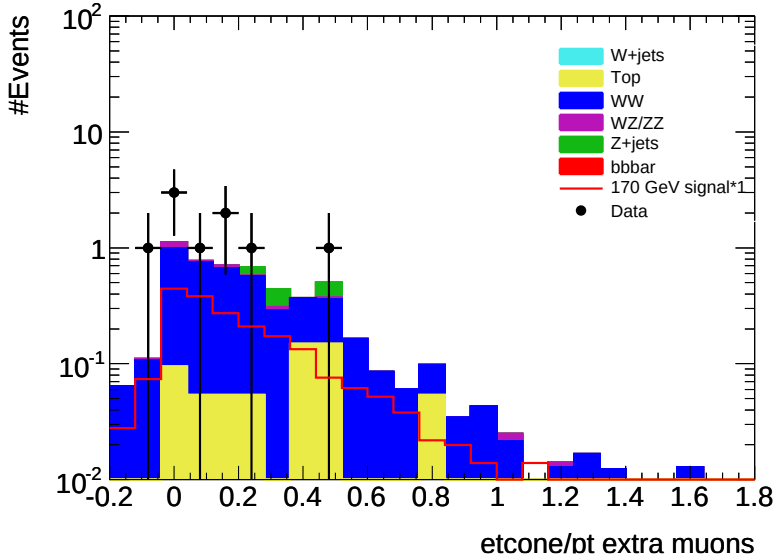


normalized calorimeter isolation etcone/et



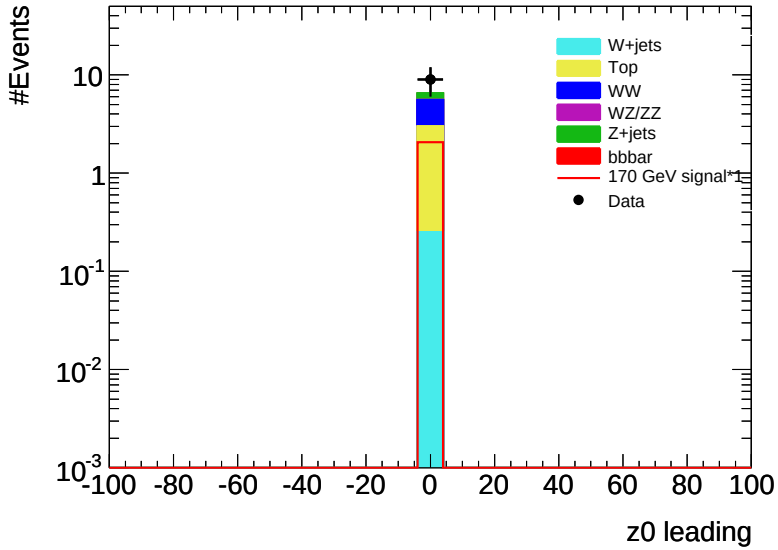


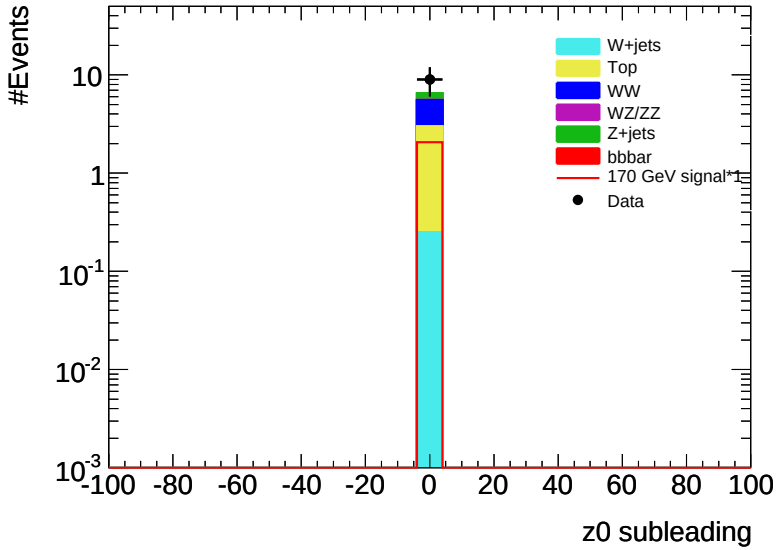
Three of nine extra muons have an well isolated cluster. Two additional ones have a sufficient isolated cluster too pass muon selection.



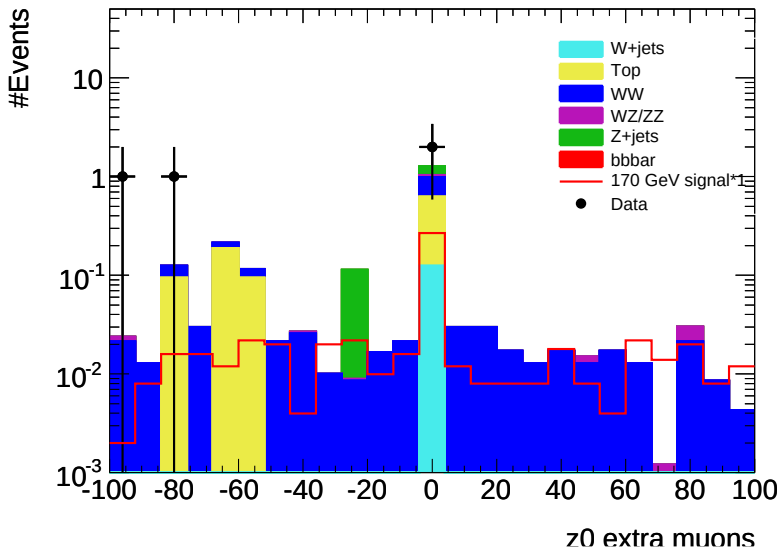
1 jet candidates

longitudinal impact parameter z_0

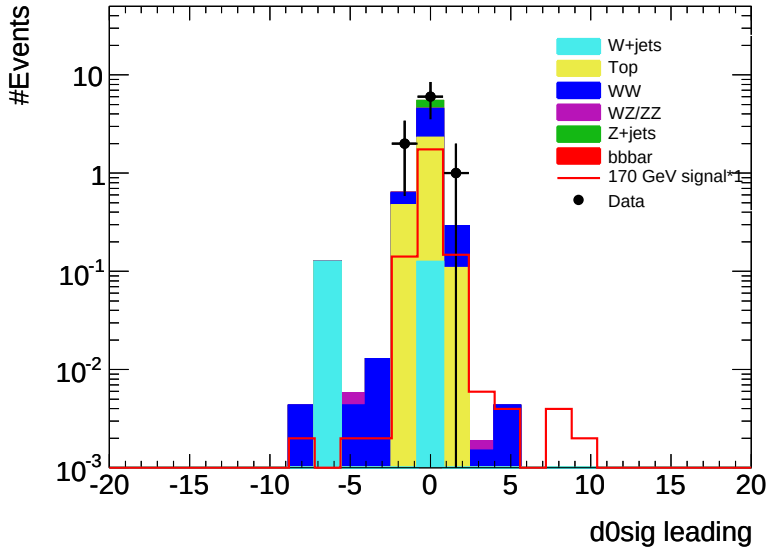


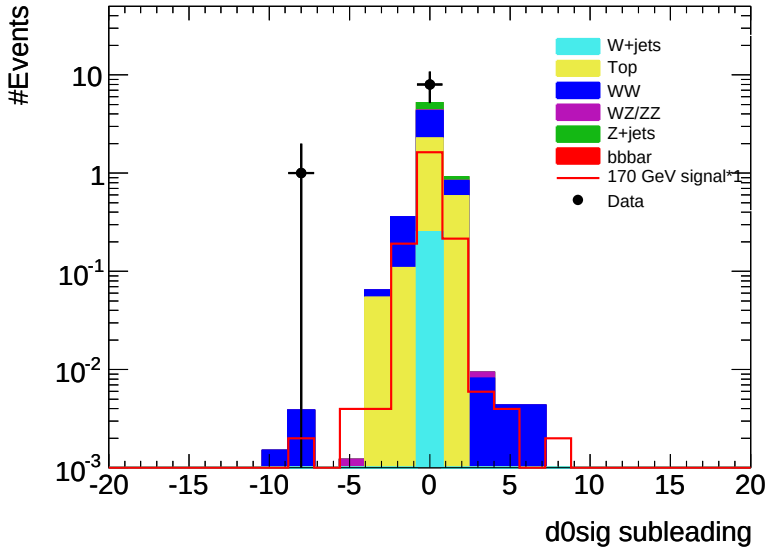


Two of four extra muons have high z_0

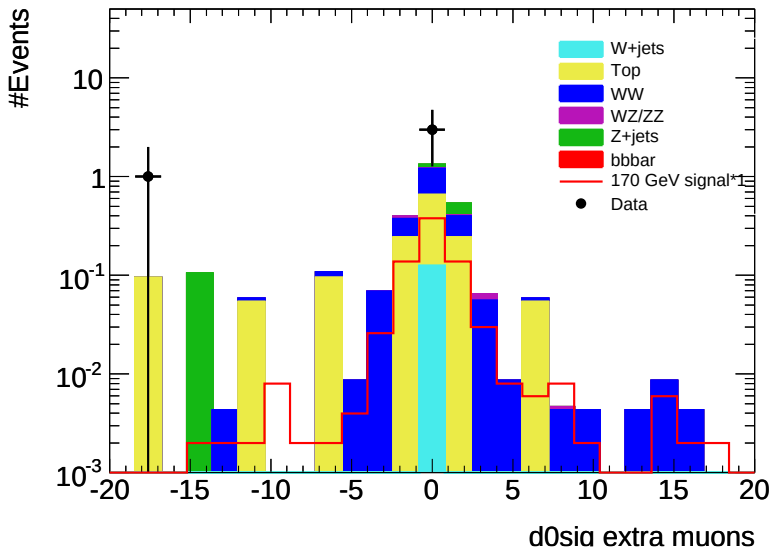


transverse impact parameter significance d_0^{sig}

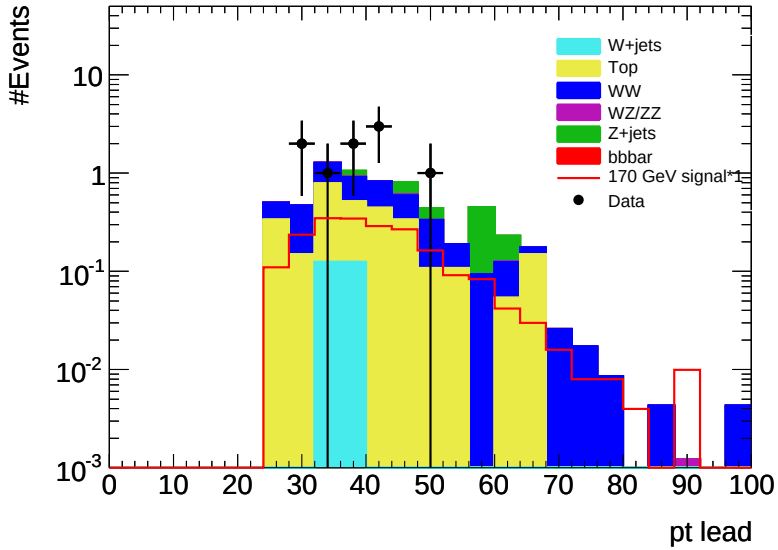


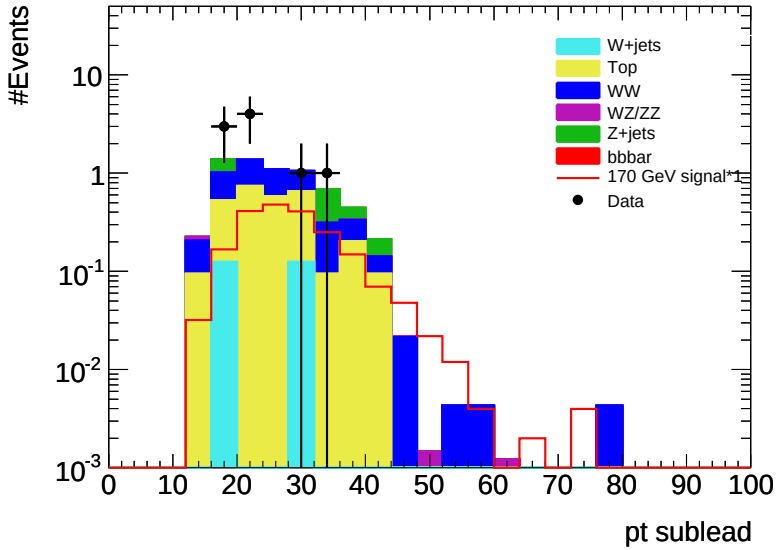


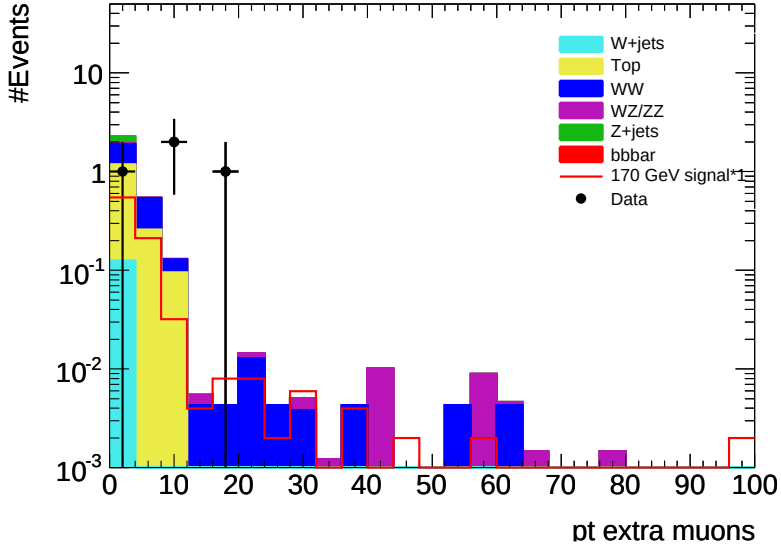
One extra muon with high d_0^{sig}.
Could come from a b-decay.



transverse momentum p_T







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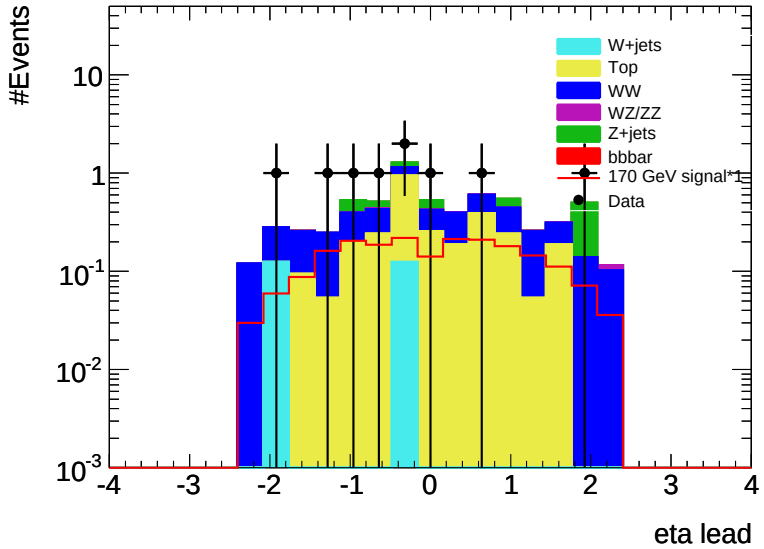
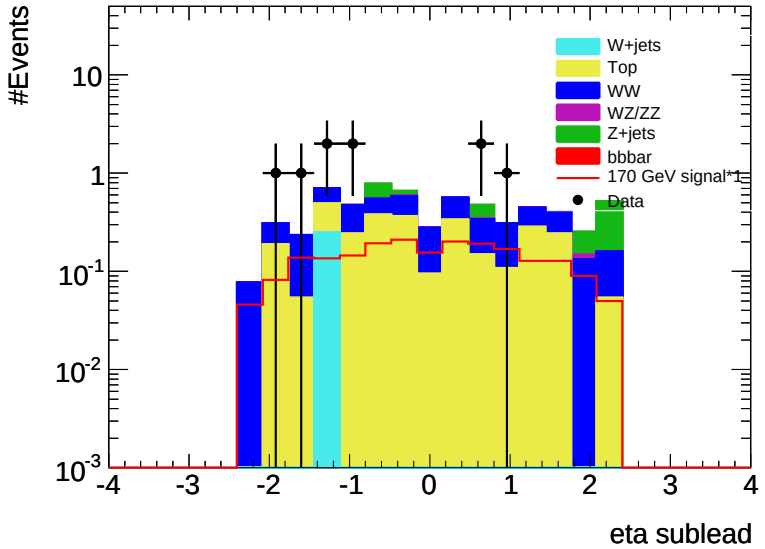
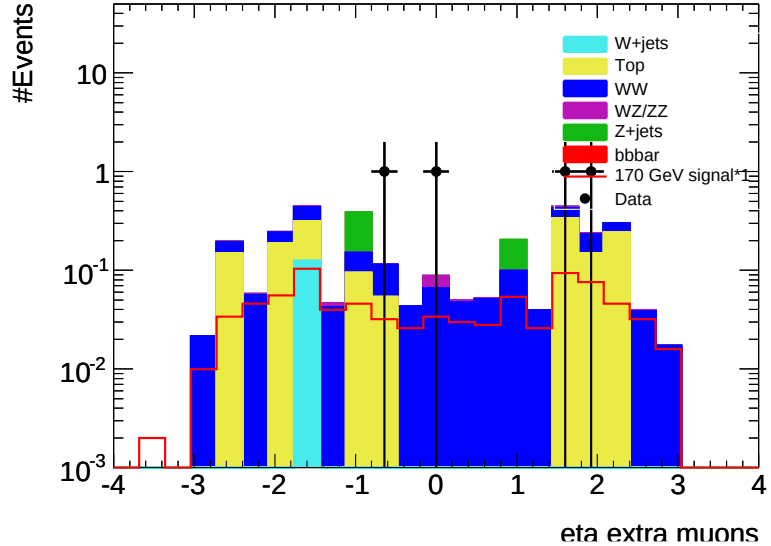
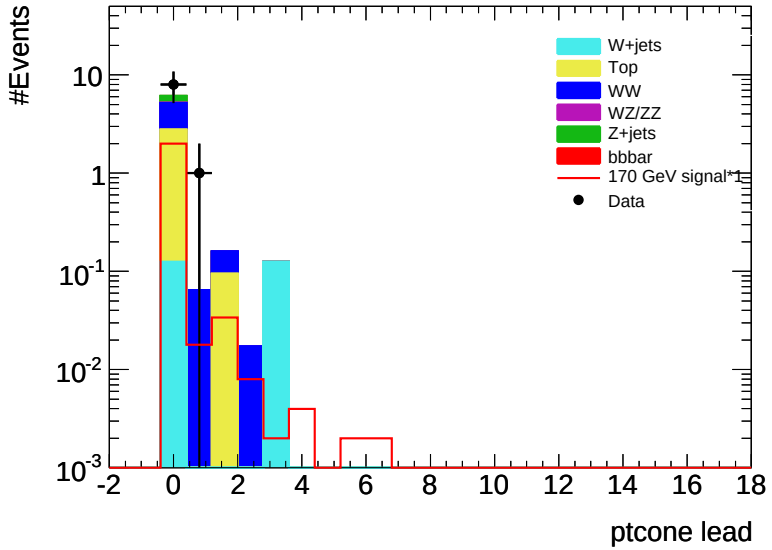
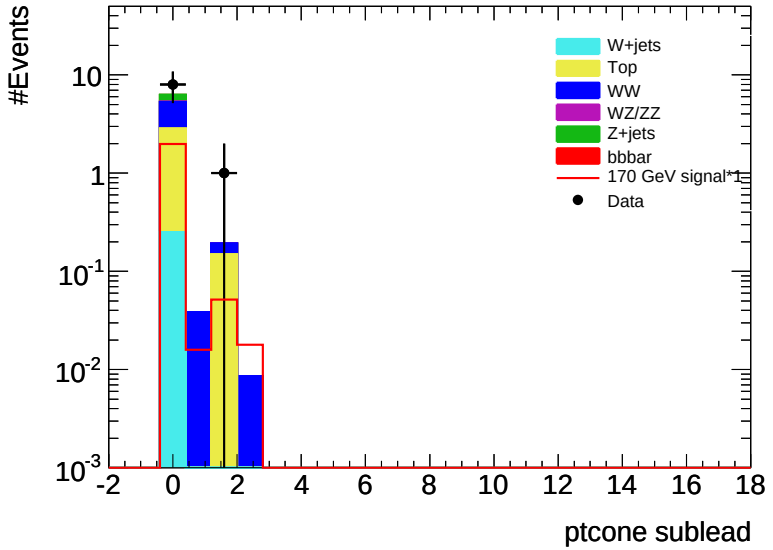

#Events
W+jets
Top
WW
WZ/ZZ
Z+jets
bbbar
170 GeV signal*1
Data
eta lead

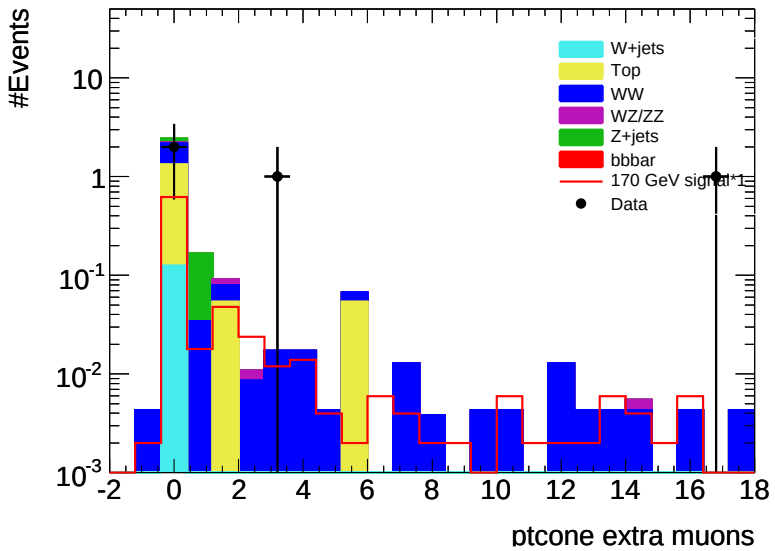

#Events
W+jets
Top
WW
WZ/ZZ
Z+jets
bbbar
170 GeV signal*1
Data
eta sublead


#Events
W+jets
Top
WW
WZ/ZZ
Z+jets
bbbar
170 GeV signal*1
Data
eta extra muons

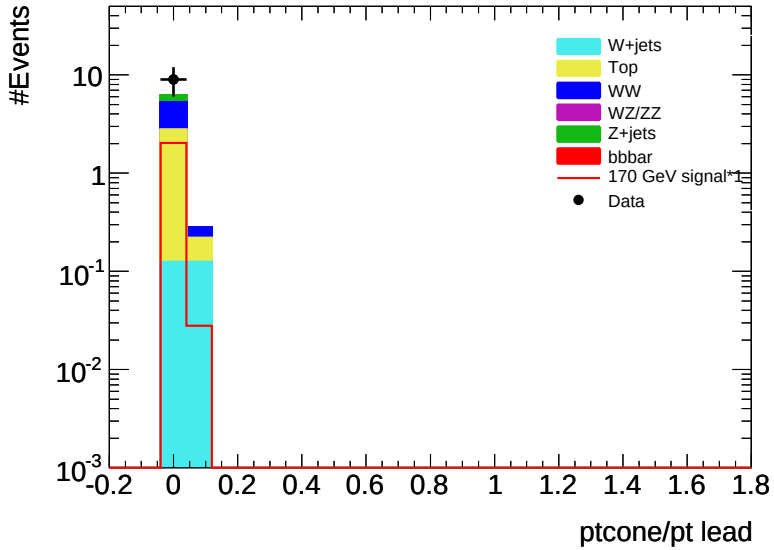
track isolation ptcone

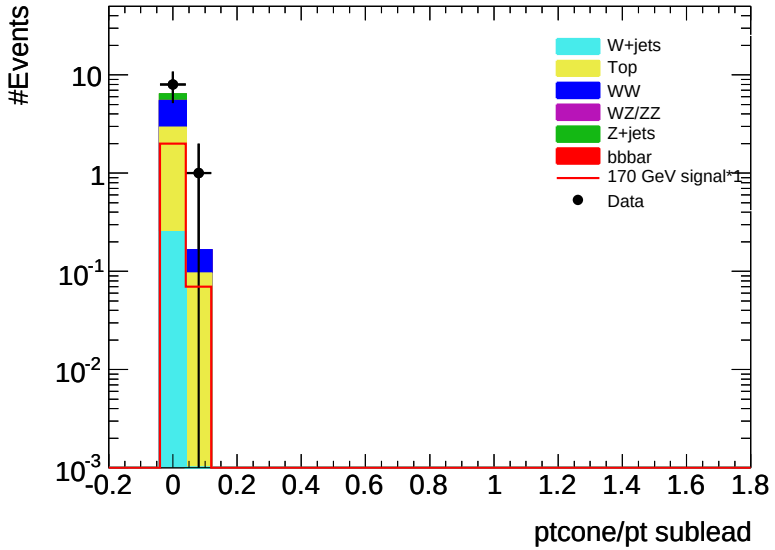




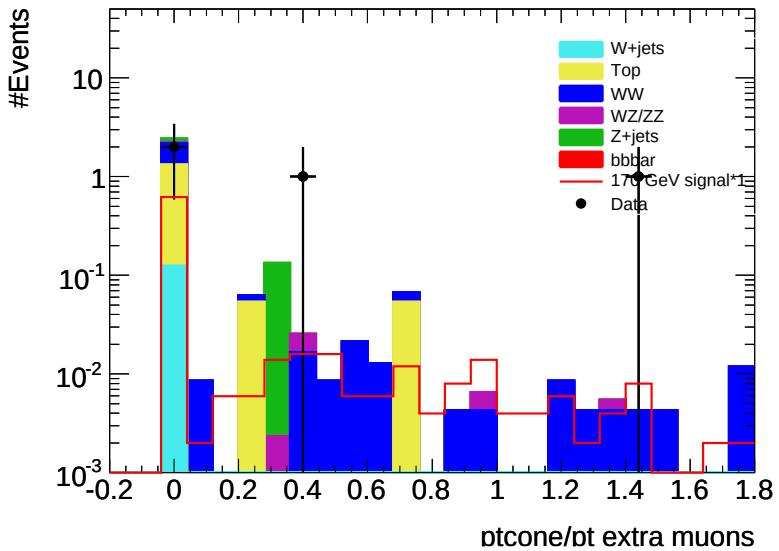


normalized track isolation ptcone/pt

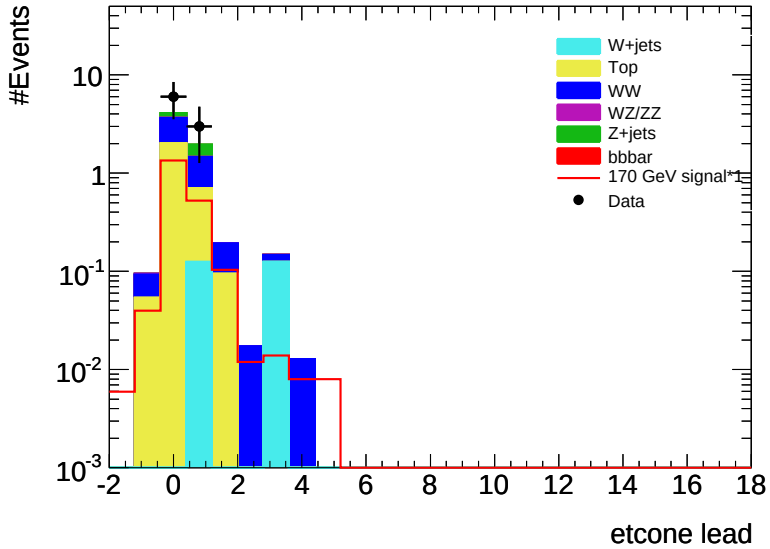


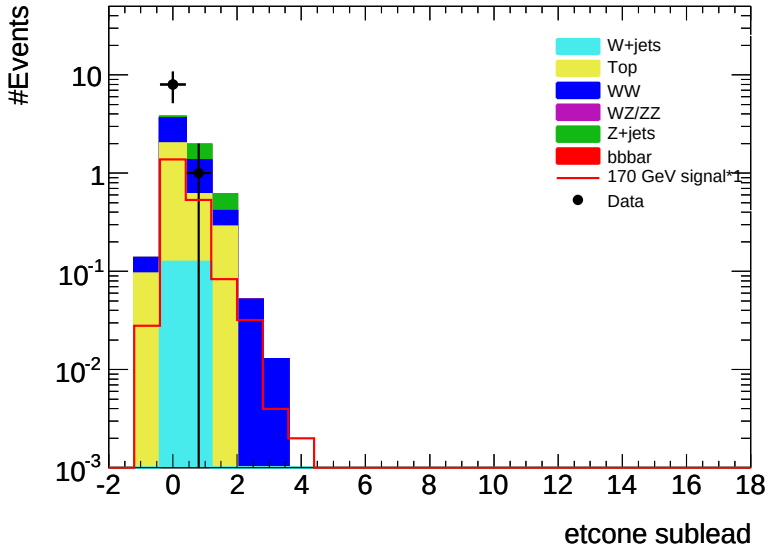


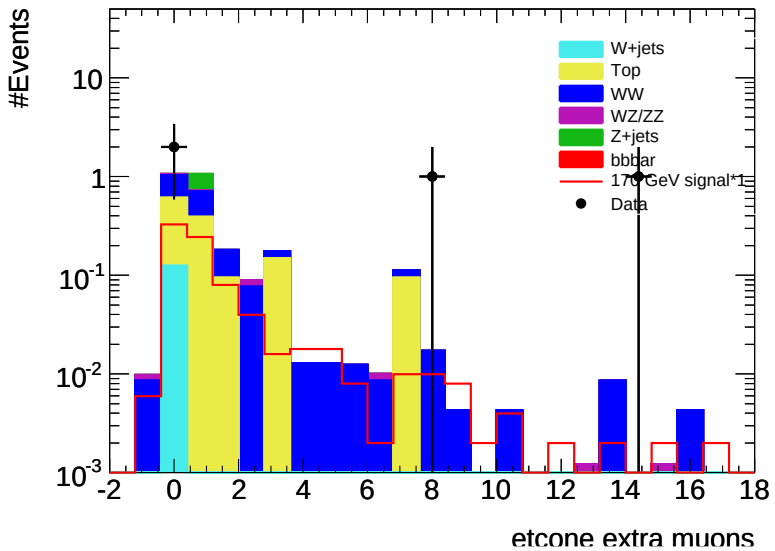
Two non isolated muons.



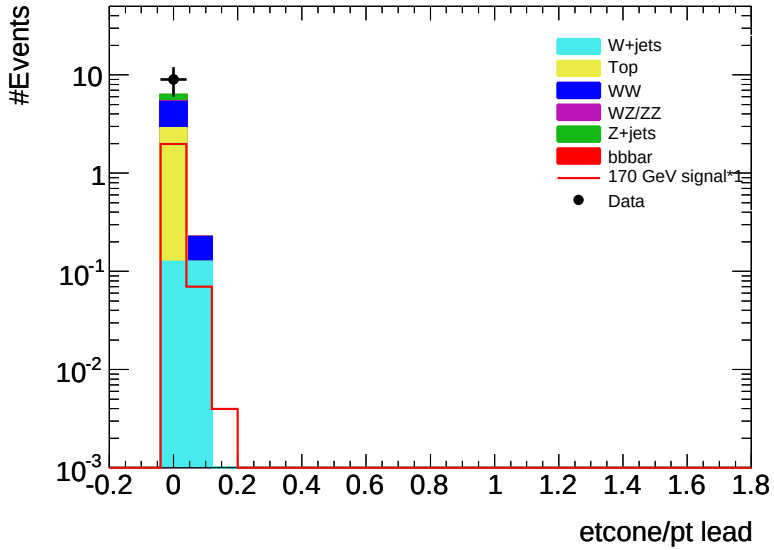
calorimeter isolation etcone

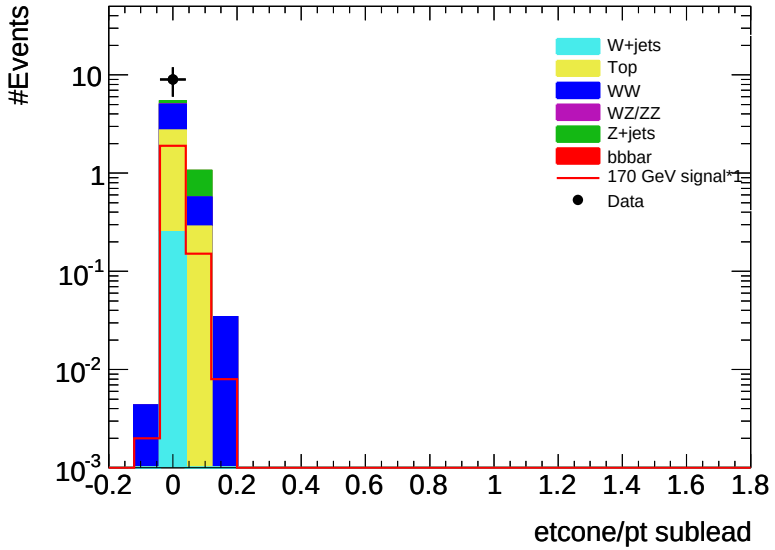


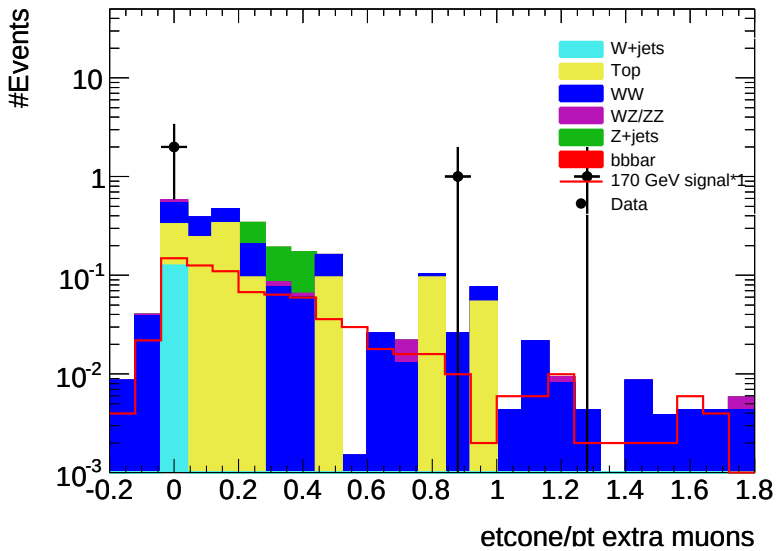




normalized calorimeter isolation etcone/et







Conlusions

- Extra Muons seem to be modeled ok.
- Extra muons in 0 jet candidates seem to come partly from pile up or additional jets.
- Same for 1 jet analysis, but additionally extra muons from b-decays from Top events expected.