

Status of 4Top analysis

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Sample status

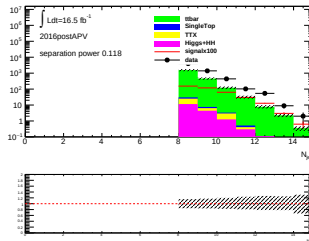
- ttW and ttZ are missing in UL2016 postAPV.
- UL2016 preAPV mc sample should be updated to RunIISummer20UL16NanoAODAPVv9-106X_mcRun2_asymptotic_preVFP_v11
 - In the current sample, Flag_BadPFMuonDzFilter, Electron_dEsigmaUp and Electron_dEsigmaDown are not available.

Yield in data and MC

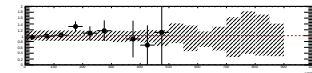
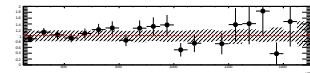
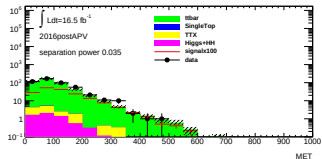
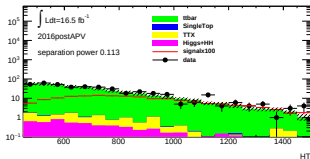
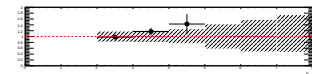
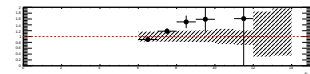
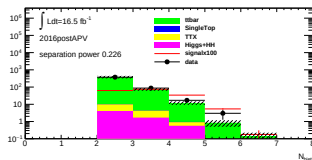
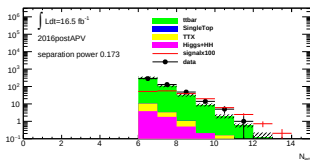
category	Data	signal	ttbar	Single top	TTX	H+HH	(data-mc)/mc
1Tau0L	5964.00	3.83	2146.25	6.81	17.37	17.58	1.726
1Tau1L	482.00	1.77	453.27	0.47	8.92	6.42	0.028
1Tau2L	6.00	0.25	7.62	0.16	-0.05	0.89	-0.304
1Tau3L	0.00	0.01	0.00	0.00	0.01	0.03	-1.000
2Tau0L	113.00	0.17	64.36	0.21	0.11	2.02	0.694
2Tau1L	3.00	0.05	3.08	0.04	-0.17	0.65	-0.166
2Tau2L	0.00	0.00	0.00	0.00	0.01	0.05	-1.000

- In last iteration, The consistency is quite good in 2Tau0L. I will investigate it.

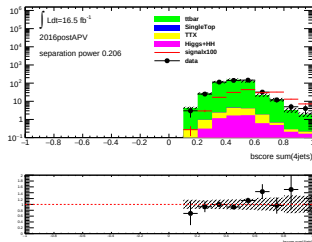
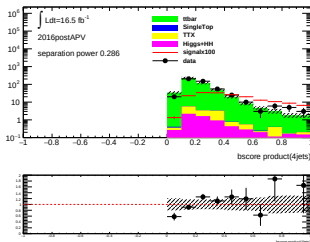
- PDF, PS
- Electron RECO/ID/ISO, and energy resolution
- Muon RECO/ID/ISO
- Tau VSjet/VSe/VSmu, and energy scale
- Jet JES/JER
- BTag
- ttbb correcion, 13%



- It is known that we should estimate the QCD by data-driven method.

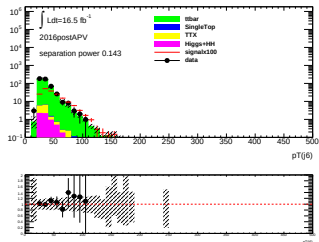
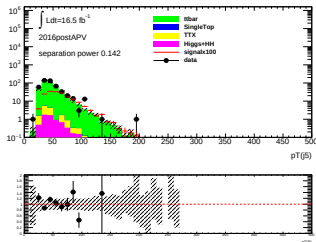


1Tau1L :bscore



- Follow Olaf's suggestion : check the geometrical mean of 4 highest bscore $(\prod_i^4 \text{bscore}_i)^{0.25}$
- It is powerful than the arithmetic mean : $0.25 \sum_i^4 \text{bscore}_i$.

1Tau1L : jet pt



Impact of systematics on tttt

tttt	1Tau0L	1Tau1L	1Tau2L	1Tau3L	2Tau0L	2Tau1L	2Tau2L
prefire	-0.0113/-0.0110	-0.0129/-0.0125	-0.0132/-0.0130	-0.0053/-0.0046	-0.0132/-0.0112	-0.0135/-0.0124	-0.0017/-0.0011
pu	0.0051/-0.0053	-0.0032/-0.0015	0.0038/-0.0064	0.0133/-0.0120	-0.0067/-0.0055	0.0168/-0.0137	0.0386/-0.0196
trigger	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
eleReco	0.0000/-0.0000	0.0003/-0.0003	0.0004/-0.0004	0.0001/-0.0001	0.0000/-0.0000	0.0001/-0.0001	-0.0001/-0.0001
eleID	0.0000/-0.0000	-0.0000/-0.0005	0.0001/-0.0007	-0.0002/-0.0006	0.0000/-0.0000	0.0003/-0.0000	0.0003/-0.0006
eleIso	0.0000/-0.0000	0.0001/-0.0001	0.0002/-0.0002	0.0001/-0.0001	0.0000/-0.0000	0.0000/-0.0000	-0.0000/-0.0000
muReco	0.0000/-0.0000	0.0174/-0.0374	0.0747/-0.0657	0.2156/-0.1979	0.0000/-0.0000	0.0000/-0.0000	-0.0000/-0.0000
muID	0.0000/-0.0000	0.0434/-0.0434	0.0880/-0.0786	0.2108/-0.1941	0.0000/-0.0000	0.0600/-0.0600	-0.1928/-0.1916
muIso	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVSjet1	0.0000/-0.0004	0.0000/-0.0003	0.0000/-0.0001	0.0000/-0.0000	0.0000/-0.0010	0.0000/-0.0003	0.0000/-0.0000
tauVSjet2	0.0001/-0.0071	0.0001/-0.0068	0.0001/-0.0083	0.0000/-0.0042	0.0002/-0.0136	0.0002/-0.0136	0.0003/-0.0299
tauVSjet3	-0.0006/-0.0069	-0.0006/-0.0068	-0.0007/-0.0081	-0.0006/-0.0063	-0.0010/-0.0113	-0.0016/-0.0175	-0.0012/-0.0131
tauVSjet4	0.0020/-0.0048	0.0020/-0.0048	0.0029/-0.0070	0.0009/-0.0022	0.0037/-0.0090	0.0026/-0.0062	-0.0072/-0.0172
tauVSjets	-0.0312/-0.1271	-0.0301/-0.1235	-0.0288/-0.1170	-0.0234/-0.1208	-0.0521/-0.1809	-0.0535/-0.1855	-0.0919/-0.2943
tauVSjet6	0.0000/-0.0002	-0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVSjet7	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVs1	0.0039/-0.0026	0.0047/-0.0029	0.0038/-0.0019	0.0041/-0.0023	0.0093/-0.0048	0.0103/-0.0063	-0.0093/-0.0016
tauVs2	-0.0025/-0.0042	-0.0027/-0.0051	-0.0016/-0.0042	-0.0021/-0.0045	-0.0042/-0.0106	-0.0061/-0.0095	0.0005/-0.0108
tauVSmu1	0.0000/-0.0000	0.0001/-0.0001	0.0000/-0.0000	0.0000/-0.0000	0.0002/-0.0002	0.0004/-0.0004	0.0000/-0.0000
tauVSmu2	0.0000/-0.0000	0.0001/-0.0001	0.0000/-0.0000	0.0000/-0.0000	0.0002/-0.0002	0.0004/-0.0004	0.0000/-0.0000
tauVSmu3	0.0000/-0.0000	0.0001/-0.0001	0.0001/-0.0001	0.0000/-0.0000	0.0004/-0.0004	0.0004/-0.0004	0.0000/-0.0000
tauVSmu4	0.0001/-0.0001	0.0002/-0.0002	0.0003/-0.0003	0.0000/-0.0000	0.0005/-0.0005	0.0004/-0.0004	0.0000/-0.0000
tauVSmu5	0.0002/-0.0002	0.0002/-0.0002	0.0003/-0.0003	0.0000/-0.0000	0.0005/-0.0005	0.0004/-0.0004	0.0000/-0.0000
btagJES	0.0990/-0.0671	0.0968/-0.0681	0.0762/-0.0616	0.0653/-0.0578	0.0916/-0.0724	0.0835/-0.0660	0.1463/-0.1186
btagHF	0.0019/-0.0019	0.0016/-0.0016	0.0019/-0.0019	-0.0008/-0.0009	0.0028/-0.0028	0.0002/-0.0003	-0.0013/-0.0012
btagLF	0.0752/-0.0725	0.0773/-0.0752	0.0798/-0.0776	0.1038/-0.1071	0.0850/-0.0817	0.0876/-0.0804	0.1790/-0.1658
btagHfstats1	-0.0179/-0.0182	-0.0183/-0.0186	-0.0193/-0.0196	-0.0268/-0.0272	-0.0202/-0.0207	-0.0238/-0.0244	-0.0484/-0.0508
btagHfstats2	-0.0027/-0.0027	0.0028/-0.0028	0.0015/-0.0015	0.0019/-0.0018	0.0013/-0.0013	0.0005/-0.0006	0.0185/-0.0194
btagHfstats1	-0.0020/-0.0020	-0.0015/-0.0015	-0.0010/-0.0010	-0.0003/-0.0004	-0.0014/-0.0015	-0.0011/-0.0011	0.0003/-0.0003
btagHfstats2	-0.0002/-0.0002	-0.0001/-0.0001	-0.0001/-0.0001	0.0002/-0.0002	0.0000/-0.0000	-0.0000/-0.0000	-0.0004/-0.0004
btagErr1	-0.0015/-0.0024	0.0001/-0.0001	-0.0048/-0.0089	-0.0025/-0.0050	0.0037/-0.0059	-0.0021/-0.0039	-0.0445/-0.0828
btagErr2	-0.0013/-0.0017	-0.0002/-0.0003	-0.0035/-0.0053	-0.0026/-0.0040	0.0034/-0.0048	-0.0056/-0.0080	-0.0429/-0.0624
isr	-0.0147/-0.0180	-0.0056/-0.0074	0.0012/-0.0027	-0.0181/-0.0216	-0.0101/-0.0118	-0.0029/-0.0011	0.0054/-0.1341
fir	0.0219/-0.0530	0.0178/-0.0431	0.0008/-0.0291	0.1299/-0.3449	0.0319/-0.0503	0.0335/-0.0742	0.0100/-0.1793
pdf	0.0749/-0.0749	0.0773/-0.0773	0.0821/-0.0821	0.0598/-0.0598	0.0707/-0.0707	0.0688/-0.0688	0.0963/-0.0963
tsbb	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
eleSigma	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVSeScale1	-0.0007/-0.0005	-0.0007/-0.0004	0.0001/-0.0015	0.0005/-0.0027	-0.0012/-0.0011	-0.0005/-0.0034	-0.0017/-0.0000
tauVSeScale1	-0.0004/-0.0005	-0.0004/-0.0004	0.0005/-0.0000	0.0002/-0.0002	-0.0005/-0.0005	-0.0009/-0.0027	0.0000/-0.0000
tauVSeScale2	-0.0004/-0.0005	-0.0004/-0.0004	0.0005/-0.0000	0.0002/-0.0002	-0.0005/-0.0005	-0.0009/-0.0027	0.0000/-0.0000
tauVSmuScale1	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVSmuScale2	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVSmuScale3	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
tauVSmuScale4	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000	0.0000/-0.0000
JER	-0.0005/-0.0031	-0.0003/-0.0036	0.0003/-0.0063	0.0015/-0.0196	-0.0012/-0.0052	-0.0007/-0.0044	0.0112/-0.0137
JEC	-0.0003/-0.0001	0.0006/-0.0010	0.0025/-0.0011	0.0182/-0.0009	-0.0029/-0.0010	-0.0015/-0.0126	-0.1236/-0.0091

- The largest uncertainty is from btagging.

Open discussion

- Should we optimize and fit preAPV and postAPV separately? since the uncertainty is different and the nuisance parameters should be uncorrelated.
- If we do separately, the expected signal yield in postAPV is small, <1 in most categories.
- In UL2017 analysis, Electron ID MVA2017V1nonIso is not available in nanoAOD but it is recommended by SUSY group.

Summary

- MC is consistent with data except 2Tau0L. It needs more checks.
- The data/mc comparison plot of kinematic variables is good in 1Tau1L.
- Geometrical mean of 4 highest bscore has good separation power.
- The largest uncertainty is about 10-15% from b-tagging.
- We should decide whether we optimize/fit preAPV/postAPV separately.

Impact of systematics on ttbar_1l

ttbar1l	1Tau0L	1Tau1L	1Tau2L	1Tau3L	2Tau0L	2Tau1L	2Tau2L
prefire	-0.0089/-0.0087	-0.0100/-0.0098	-0.0101/-0.0100	null	-0.0090/-0.0088	-0.0098/-0.0097	null
pu	0.0119/-0.0107	0.0075/-0.0103	0.0213/-0.0376	null	0.0114/-0.0130	-0.0436/-0.0346	null
trigger	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
elecReco	0.0000/0.0000	0.0003/-0.0003	0.0033/-0.0033	null	0.0000/0.0000	0.0000/-0.0000	null
elecID	0.0000/0.0000	-0.0001/-0.0005	0.0022/0.0002	null	0.0000/0.0000	-0.0000/-0.0004	null
elecIso	0.0000/0.0000	0.0001/-0.0001	0.0006/-0.0006	null	0.0000/0.0000	0.0000/-0.0000	null
muReco	0.0000/0.0000	0.0473/-0.0473	0.0000/0.0000	null	0.0000/0.0000	0.1348/-0.1348	null
muID	0.0000/0.0000	0.0545/-0.0545	0.0000/0.0000	null	0.0000/0.0000	0.1442/-0.1442	null
muIso	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSjet1	0.0000/-0.0004	0.0000/0.0000	0.0000/0.0000	null	0.0000/-0.0012	0.0000/0.0000	null
tauVSjet2	0.0001/-0.0101	0.0000/-0.0002	0.0000/0.0000	null	0.0001/-0.0112	0.0000/0.0000	null
tauVSjet3	-0.0009/-0.0096	-0.0009/-0.0001	0.0000/0.0000	null	-0.0009/-0.0099	0.0000/0.0000	null
tauVSjet4	0.0028/-0.0068	0.0000/-0.0001	0.0000/0.0000	null	0.0032/-0.0076	0.0000/0.0000	null
tauVSjet5	-0.0342/-0.1179	-0.0006/-0.0018	0.0000/0.0000	null	-0.0341/-0.1205	0.0000/0.0000	null
tauVSjet6	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSjet7	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSe1	0.0054/-0.0036	0.0000/-0.0000	0.0000/0.0000	null	0.0055/-0.0035	0.0000/0.0000	null
tauVSe2	-0.0034/-0.0058	-0.0000/-0.0000	0.0000/0.0000	null	-0.0033/-0.0059	0.0000/0.0000	null
tauVSmu1	0.0001/-0.0001	0.0000/-0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSmu2	0.0001/-0.0001	0.0000/-0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSmu3	0.0001/-0.0001	0.0000/-0.0000	0.0000/0.0000	null	0.0001/-0.0001	0.0000/0.0000	null
tauVSmu4	0.0002/-0.0002	0.0000/-0.0000	0.0000/0.0000	null	0.0002/-0.0002	0.0000/0.0000	null
tauVSmu5	0.0003/-0.0003	0.0000/-0.0000	0.0000/0.0000	null	0.0002/-0.0002	0.0000/0.0000	null
btagJES	0.1103/-0.0855	0.0968/-0.0762	0.0825/-0.0615	null	0.0973/-0.0769	0.0886/-0.0707	null
btagHF	0.0004/-0.0003	-0.0004/0.0003	0.0066/-0.0066	null	0.0032/-0.0032	-0.0039/0.0040	null
btagLF	0.0763/-0.0732	0.0832/-0.0793	0.0813/-0.0794	null	0.0813/-0.0775	0.0932/-0.0889	null
btagHfsts1	-0.0173/-0.0176	-0.0185/-0.0188	-0.0201/0.0205	null	-0.0184/0.0188	-0.0201/0.0204	null
btagHfsts2	0.0011/-0.0011	0.0008/-0.0008	0.0022/-0.0022	null	0.0017/-0.0017	-0.0011/0.0012	null
btagHfsts1	-0.0025/-0.0025	-0.0018/-0.0018	-0.0007/0.0007	null	-0.0018/0.0018	-0.0015/0.0015	null
btagHfsts2	-0.0005/0.0005	-0.0004/0.0004	0.0014/-0.0014	null	-0.0002/0.0002	-0.0006/0.0006	null
btagIEtr1	-0.0079/0.0138	-0.0082/0.0152	-0.0954/0.1029	null	-0.0082/0.0145	-0.0066/0.0204	null
btagIEtr2	-0.0066/0.0096	-0.0067/0.0097	-0.0660/0.0960	null	-0.0066/0.0092	-0.0101/0.0211	null
fsr	-0.0641/0.0848	-0.0539/0.0700	-0.0444/0.0577	null	-0.0515/0.0688	-0.0338/0.0401	null
pdf	-0.0462/0.0462	0.0409/-0.0791	-0.0383/0.5216	null	0.0151/-0.0644	0.0769/-0.2210	null
ttbb	0.0186/-0.0186	0.0428/-0.0428	0.0292/-0.0292	null	0.0409/-0.0409	0.0349/-0.0349	null
eleSigma	0.0186/-0.0186	0.0162/-0.0162	0.0258/-0.0258	null	0.0166/-0.0166	0.0122/-0.0122	null
tauVSjetScale1	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSeScale1	-0.0006/0.0006	0.0000/-0.0001	0.0000/0.0000	null	-0.0012/-0.0016	0.0000/0.0000	null
tauVSeScale2	-0.0004/-0.0004	-0.0000/-0.0000	0.0000/0.0000	null	-0.0008/-0.0008	0.0000/0.0000	null
tauVSmuScale1	-0.0003/-0.0004	-0.0000/-0.0000	0.0000/0.0000	null	-0.0007/-0.0008	0.0000/0.0000	null
tauVSmuScale2	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSmuScale3	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
tauVSmuScale4	0.0000/0.0000	0.0000/0.0000	0.0000/0.0000	null	0.0000/0.0000	0.0000/0.0000	null
JER	0.0003/0.0105	0.0006/0.0230	0.0000/0.0504	null	-0.0001/0.0322	0.0000/0.0487	null