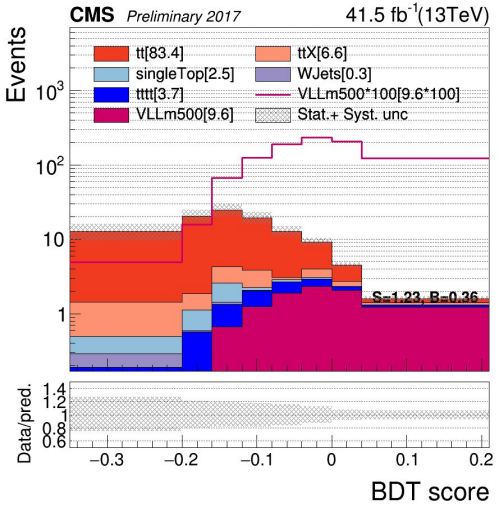
Analysis of 4top process with VLL model(2017)

The optimization of binning at different mass points

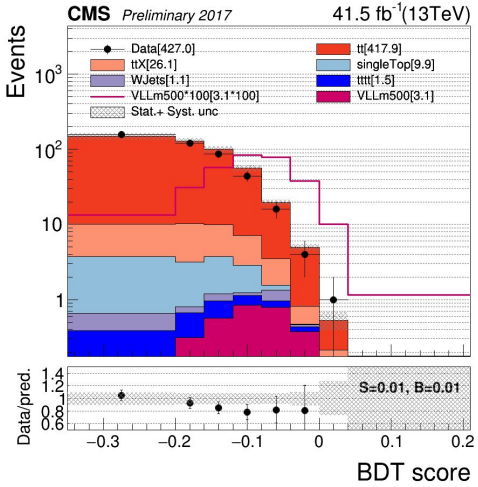
VLLm500 best bin(last bin: 0.04-0.2)



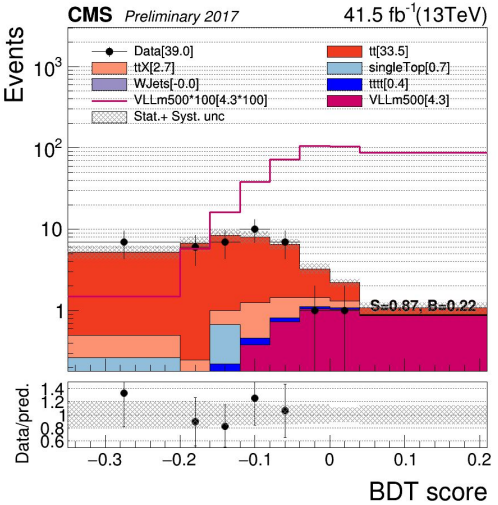
SR

limit: 1.16

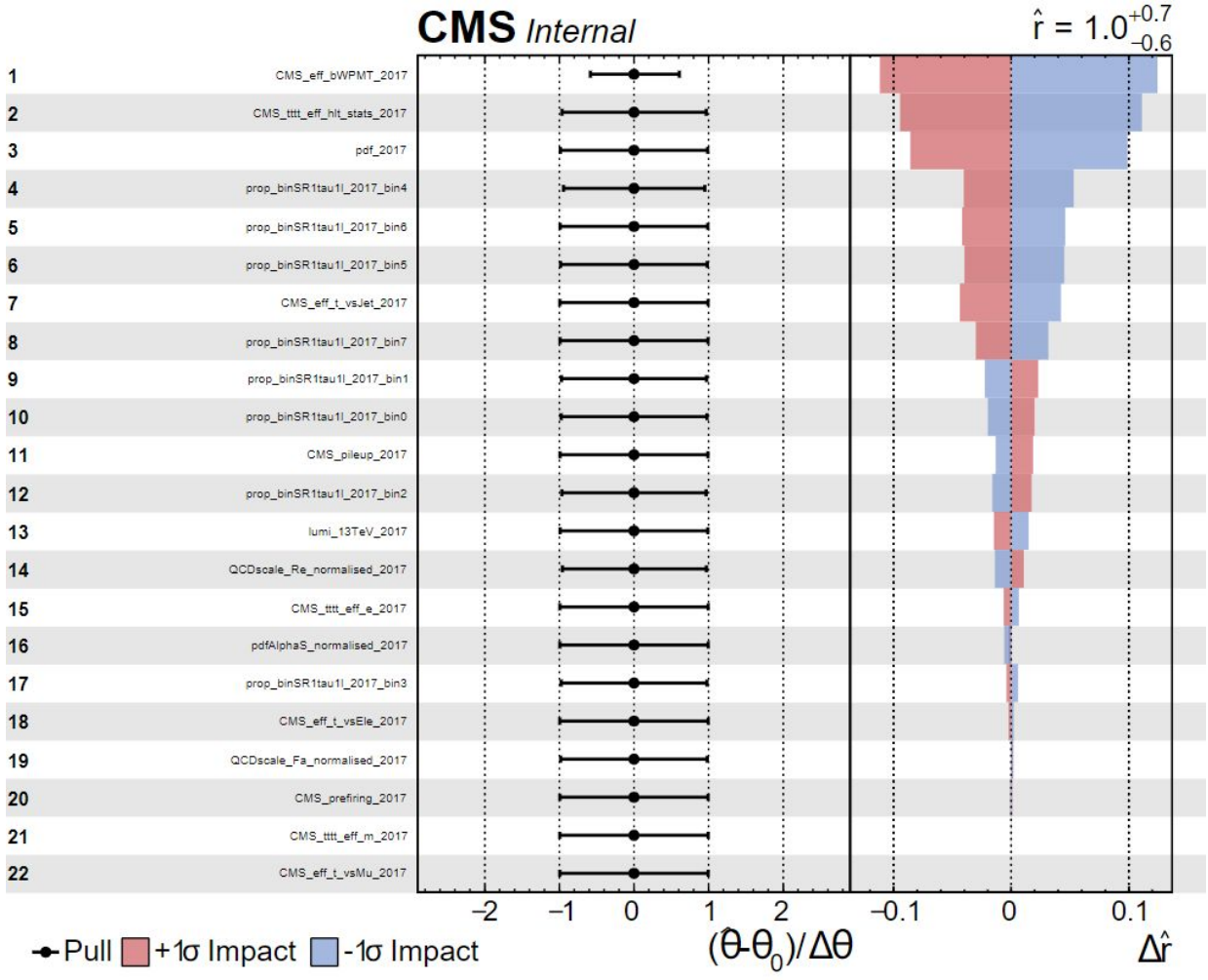
significance: 2.03



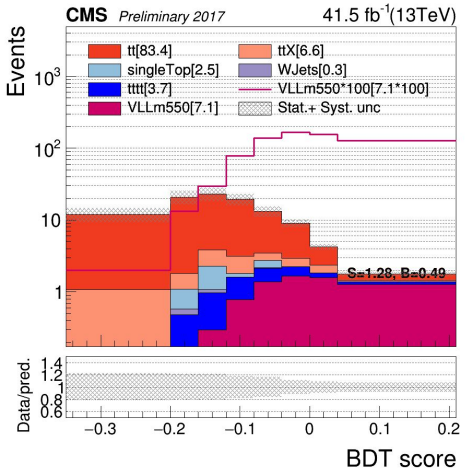
CR1

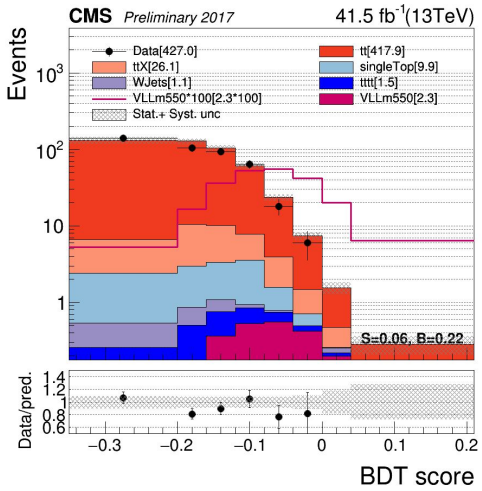


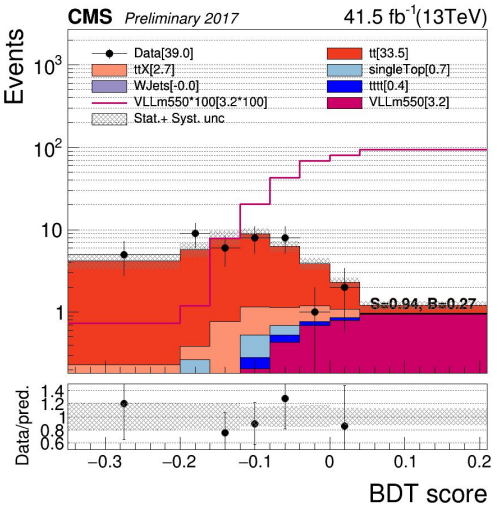
CR2


CMS Internal
$\hat{r} = 1.0^{+0.7}_{-0.6}$
1 CMS_eff_bWPMT_2017
2 CMS_tttt_eff_hlt_stats_2017
3 pdf_2017
4 prop_binSR1tau1l_2017_bin4
5 prop_binSR1tau1l_2017_bin6
6 prop_binSR1tau1l_2017_bin5
7 CMS_eff_t_vsJet_2017
8 prop_binSR1tau1l_2017_bin7
9 prop_binSR1tau1l_2017_bin1
10 prop_binSR1tau1l_2017_bin0
11 CMS_pileup_2017
12 prop_binSR1tau1l_2017_bin2
13 lumi_13TeV_2017
14 QCDscale_Re_normalised_2017
15 CMS_tttt_eff_e_2017
16 pdfAlphaS_normalised_2017
17 prop_binSR1tau1l_2017_bin3
18 CMS_eff_t_vsEle_2017
19 QCDscale_Fa_normalised_2017
20 CMS_prefiring_2017
21 CMS_tttt_eff_m_2017
22 CMS_eff_t_vsMu_2017
−2 −1 0 1 2
−0.1 0 0.1
Pull
+1σ Impact
-1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

VLLm550 best bin(last bin: 0.04-0.2)







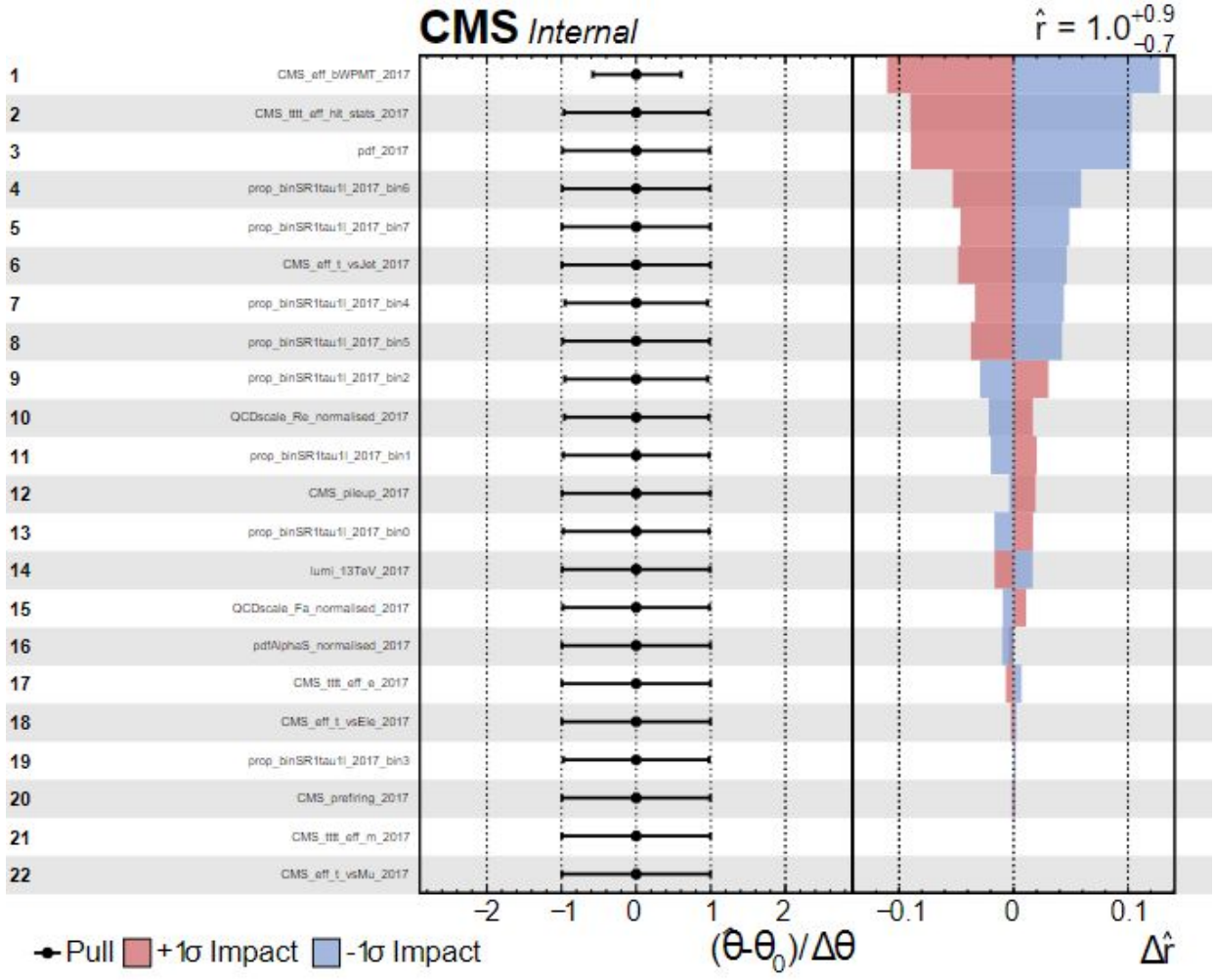
SR

limit: 1.44

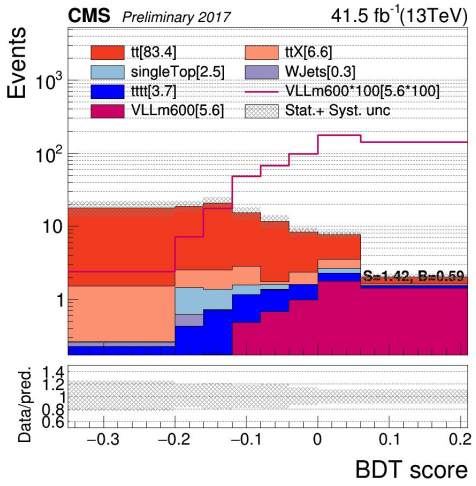
significance: 1.71

CR1

CR2


CMS Internal
$\hat{r} = 1.0^{+0.9}_{-0.7}$
1 CMS_eff_bWPMT_2017
2 CMS_ttt_eff_hlt_stats_2017
3 pdf_2017
4 prop_binSR1tau1l_2017_bin6
5 prop_binSR1tau1l_2017_bin7
6 CMS_eff_t_vsJet_2017
7 prop_binSR1tau1l_2017_bin4
8 prop_binSR1tau1l_2017_bin5
9 prop_binSR1tau1l_2017_bin2
10 QCDscale_Re_normalised_2017
11 prop_binSR1tau1l_2017_bin1
12 CMS_pileup_2017
13 prop_binSR1tau1l_2017_bin0
14 lumi_13TeV_2017
15 QCDscale_Fa_normalised_2017
16 pdfAlphaS_normalised_2017
17 CMS_ttt_eff_e_2017
18 CMS_eff_t_vsEle_2017
19 prop_binSR1tau1l_2017_bin3
20 CMS_prefiring_2017
21 CMS_ttt_eff_m_2017
22 CMS_eff_t_vsMu_2017
−2 −1 0 1 2
−0.1 0 0.1
Pull
+1σ Impact
-1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

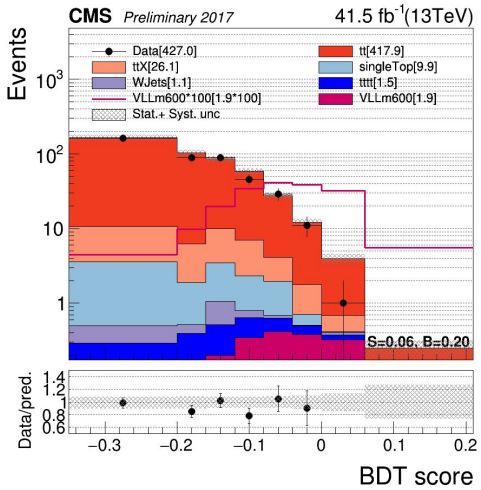
VLLm600 best bin(last bin: 0.06-0.2)



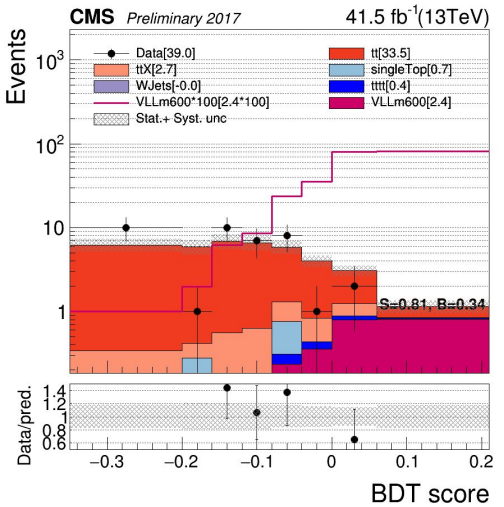
SR

limit: 1.65

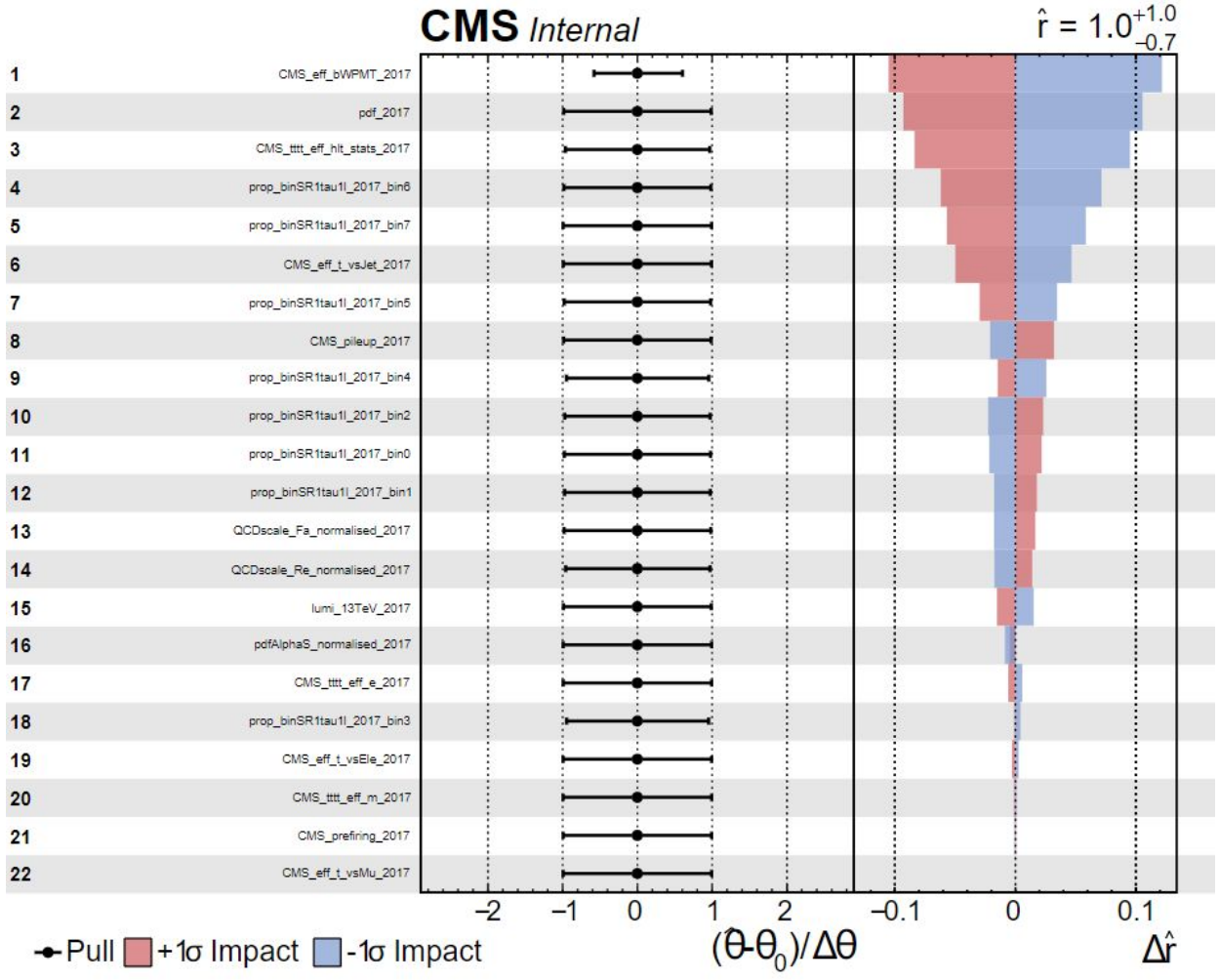
significance: 1.57



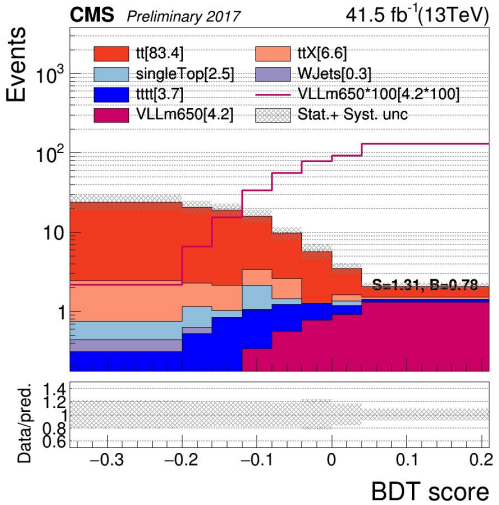
CR1



CR2


CMS Internal
$\hat{r} = 1.0^{+1.0}_{-0.7}$
1 CMS_eff_bWPMT_2017
2 pdf_2017
3 CMS_tttt_eff_hlt_stats_2017
4 prop_binSR1tau1l_2017_bin6
5 prop_binSR1tau1l_2017_bin7
6 CMS_eff_t_vsJet_2017
7 prop_binSR1tau1l_2017_bin5
8 CMS_pileup_2017
9 prop_binSR1tau1l_2017_bin4
10 prop_binSR1tau1l_2017_bin2
11 prop_binSR1tau1l_2017_bin0
12 prop_binSR1tau1l_2017_bin1
13 QCDscale_Fa_normalised_2017
14 QCDscale_Re_normalised_2017
15 lumi_13TeV_2017
16 pdfAlphaS_normalised_2017
17 CMS_tttt_eff_e_2017
18 prop_binSR1tau1l_2017_bin3
19 CMS_eff_t_vsEle_2017
20 CMS_tttt_eff_m_2017
21 CMS_prefiring_2017
22 CMS_eff_t_vsMu_2017
−2 −1 0 1 2
−0.1 0 0.1
Pull
+1σ Impact
-1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

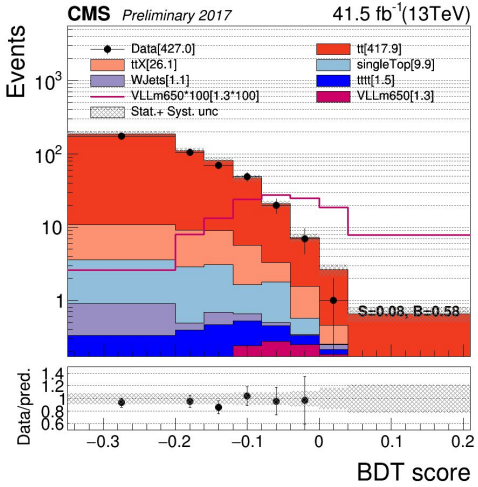
VLLm650 best bin(last bin: 0.04-0.2)



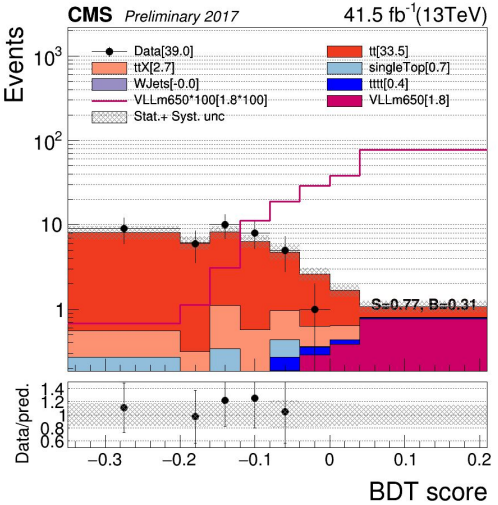
SR

limit: 1.96

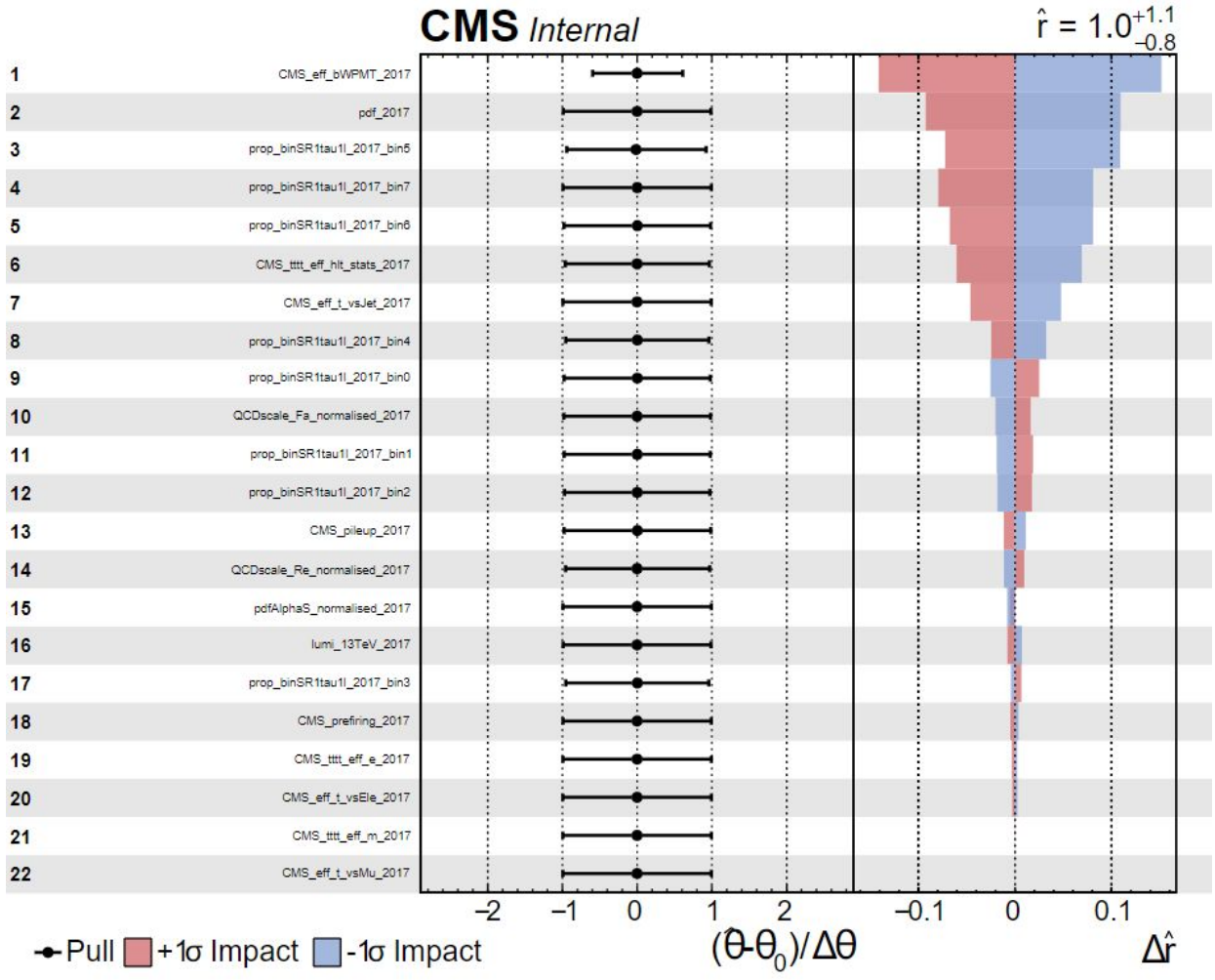
significance: 1.33



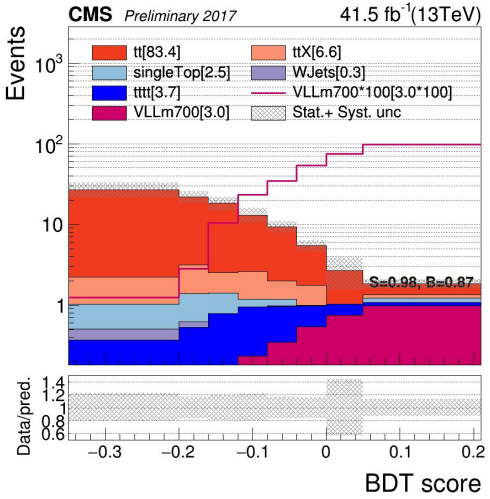
CR1



CR2


CMS Internal
$\hat{r} = 1.0^{+1.1}_{-0.8}$
1 CMS_eff_bWPMT_2017
2 pdf_2017
3 prop_binSR1tau1l_2017_bin5
4 prop_binSR1tau1l_2017_bin7
5 prop_binSR1tau1l_2017_bin6
6 CMS_tttt_eff_hlt_stats_2017
7 CMS_eff_t_vsJet_2017
8 prop_binSR1tau1l_2017_bin4
9 prop_binSR1tau1l_2017_bin0
10 QCDscale_Fa_normalised_2017
11 prop_binSR1tau1l_2017_bin1
12 prop_binSR1tau1l_2017_bin2
13 CMS_pileup_2017
14 QCDscale_Re_normalised_2017
15 pdfAlphaS_normalised_2017
16 lumi_13TeV_2017
17 prop_binSR1tau1l_2017_bin3
18 CMS_prefiring_2017
19 CMS_tttt_eff_e_2017
20 CMS_eff_t_vsEle_2017
21 CMS_tttt_eff_m_2017
22 CMS_eff_t_vsMu_2017
−2 −1 0 1 2
−0.1 0 0.1
Pull
+1σ Impact
-1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

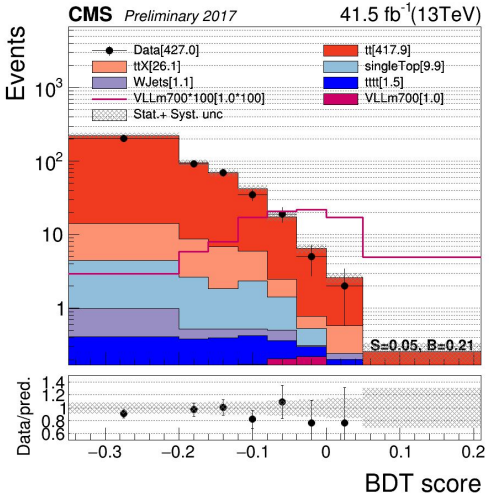
VLLm700 best bin(last bin: 0.05-0.2)



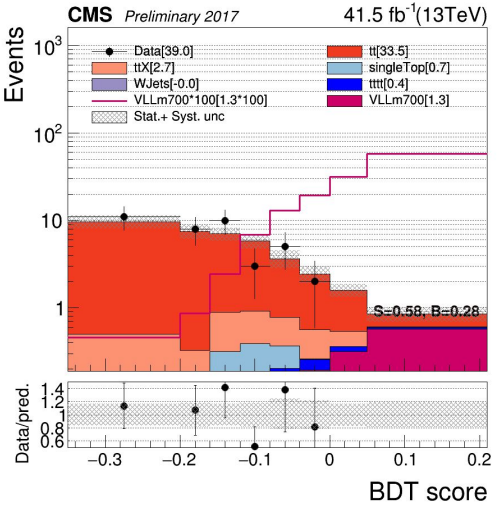
SR

limit: 2.70

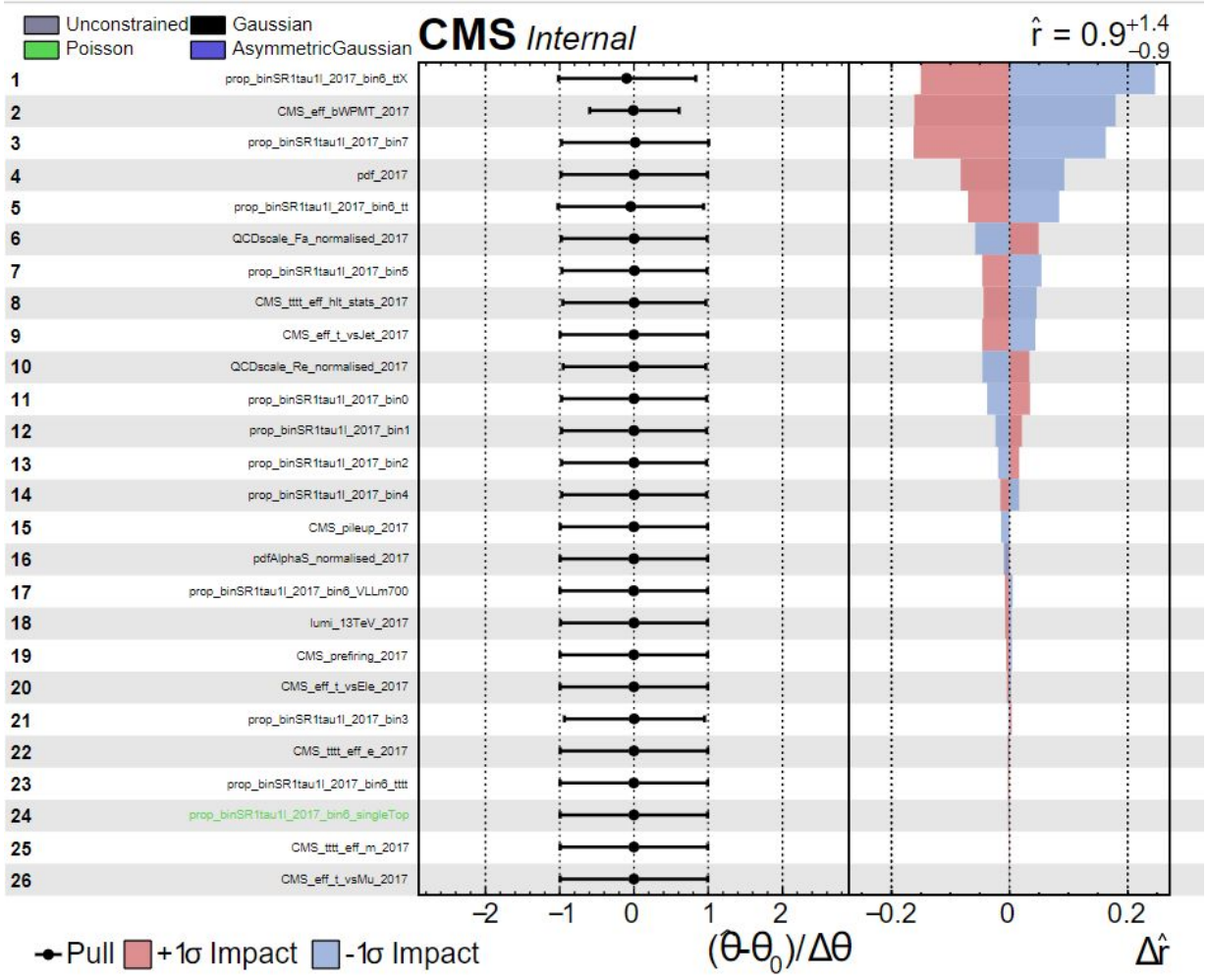
significance: 0.97



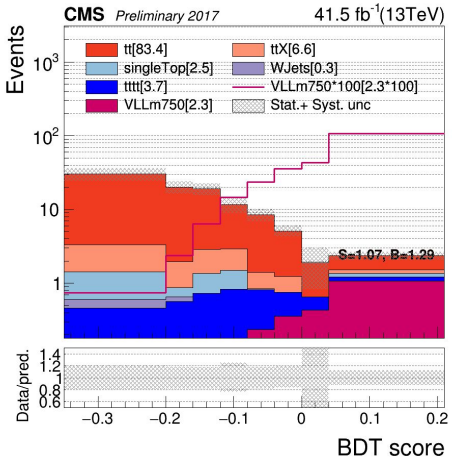
CR1



CR2


Unconstrained
Gaussian
Poisson
AsymmetricGaussian
CMS Internal
$\hat{r} = 0.9^{+1.4}_{-0.9}$
1 prop_binSR1tau1l_2017_bin6_ttX
2 CMS_eff_bWPMT_2017
3 prop_binSR1tau1l_2017_bin7
4 pdf_2017
5 prop_binSR1tau1l_2017_bin6_tt
6 QCDscale_Fa_normalised_2017
7 prop_binSR1tau1l_2017_bin5
8 CMS_tttt_eff_hlt_stats_2017
9 CMS_eff_t_vsJet_2017
10 QCDscale_Re_normalised_2017
11 prop_binSR1tau1l_2017_bin0
12 prop_binSR1tau1l_2017_bin1
13 prop_binSR1tau1l_2017_bin2
14 prop_binSR1tau1l_2017_bin4
15 CMS_pileup_2017
16 pdfAlphaS_normalised_2017
17 prop_binSR1tau1l_2017_bin6_VLLm700
18 lumi_13TeV_2017
19 CMS_prefiring_2017
20 CMS_eff_t_vsEle_2017
21 prop_binSR1tau1l_2017_bin3
22 CMS_tttt_eff_e_2017
23 prop_binSR1tau1l_2017_bin6_tttt
24 prop_binSR1tau1l_2017_bin6_singleTop
25 CMS_tttt_eff_m_2017
26 CMS_eff_t_vsMu_2017
−2 −1 0 1 2
−0.2 0 0.2
Pull +1σ Impact -1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

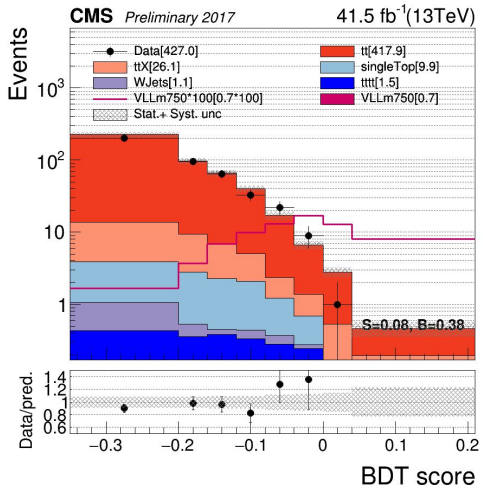
VLLm750 best bin(last bin: 0.04-0.2)



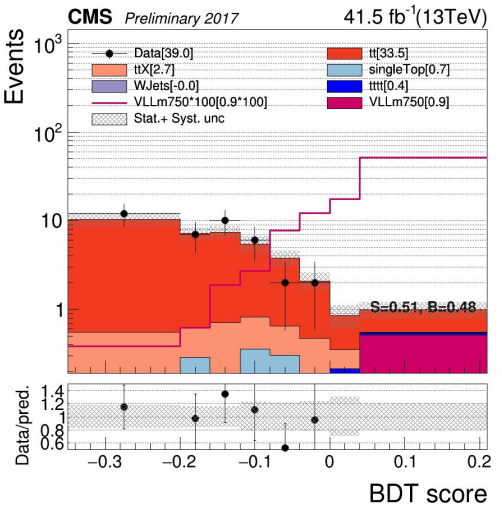
SR

limit: 3.14

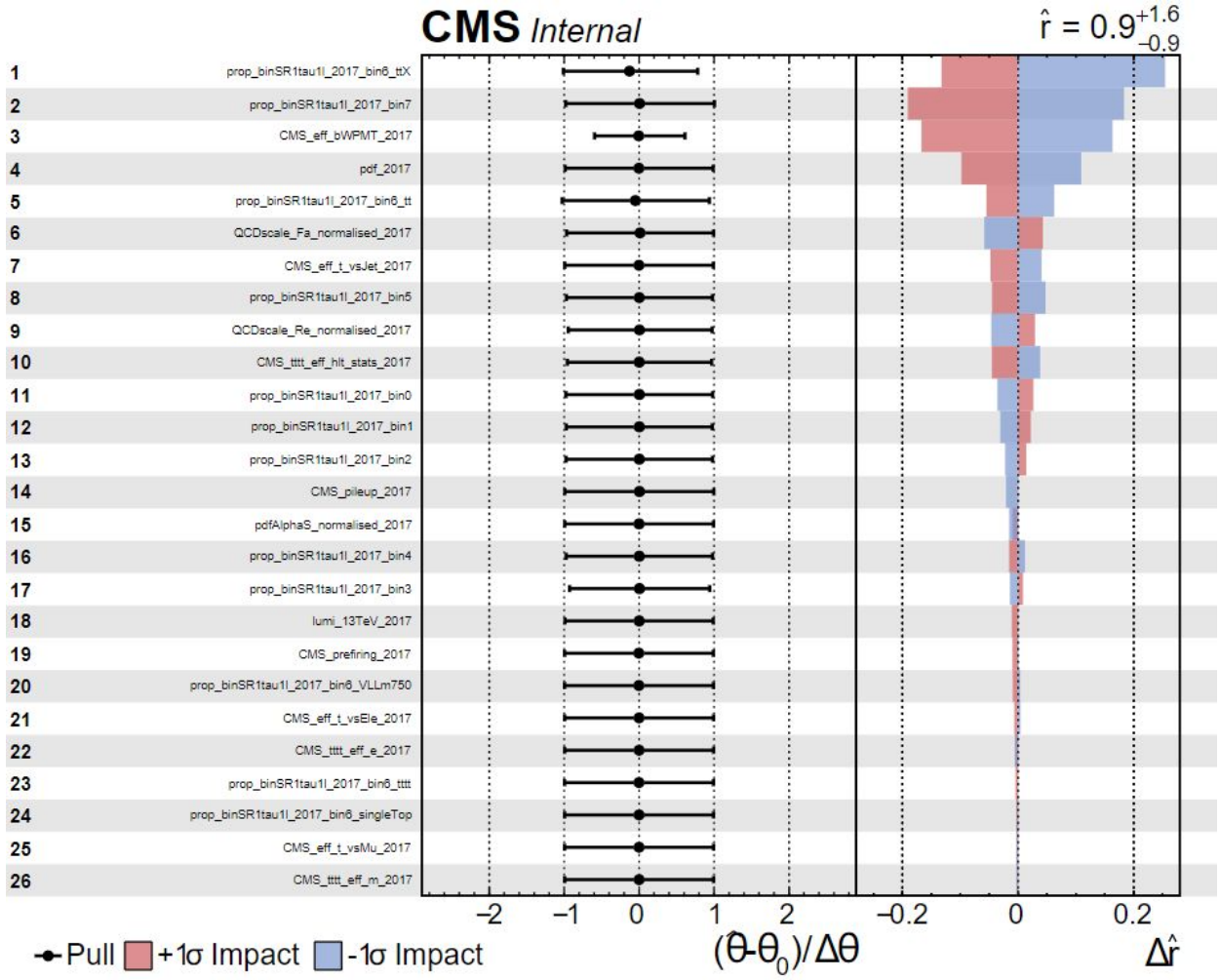
significance: 0.85



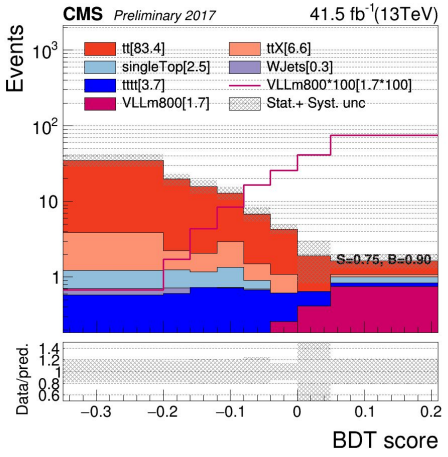
CR1

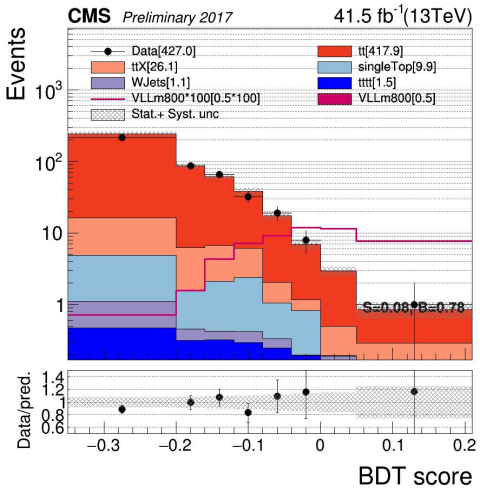


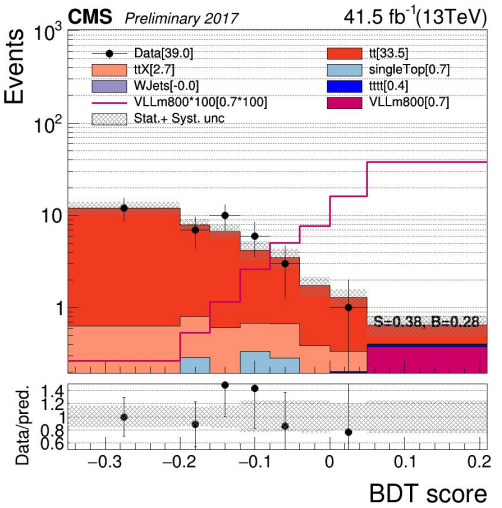
CR2


CMS Internal
$\hat{r} = 0.9^{+1.6}_{-0.9}$
1 prop_binSR1tau1l_2017_bin6_ttX
2 prop_binSR1tau1l_2017_bin7
3 CMS_eff_bWPMT_2017
4 pdf_2017
5 prop_binSR1tau1l_2017_bin6_tt
6 QCDscale_Fa_normalised_2017
7 CMS_eff_t_vsJet_2017
8 prop_binSR1tau1l_2017_bin5
9 QCDscale_Re_normalised_2017
10 CMS_tttt_eff_hlt_stats_2017
11 prop_binSR1tau1l_2017_bin0
12 prop_binSR1tau1l_2017_bin1
13 prop_binSR1tau1l_2017_bin2
14 CMS_pileup_2017
15 pdfAlphaS_normalised_2017
16 prop_binSR1tau1l_2017_bin4
17 prop_binSR1tau1l_2017_bin3
18 lumi_13TeV_2017
19 CMS_prefiring_2017
20 prop_binSR1tau1l_2017_bin6_VLLm750
21 CMS_eff_t_vsEle_2017
22 CMS_tttt_eff_e_2017
23 prop_binSR1tau1l_2017_bin6_tttt
24 prop_binSR1tau1l_2017_bin6_singleTop
25 CMS_eff_t_vsMu_2017
26 CMS_tttt_eff_m_2017
−2 −1 0 1 2
−0.2 0 0.2
Pull +1σ Impact -1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

VLLm800 best bin(last bin: 0.05-0.2)







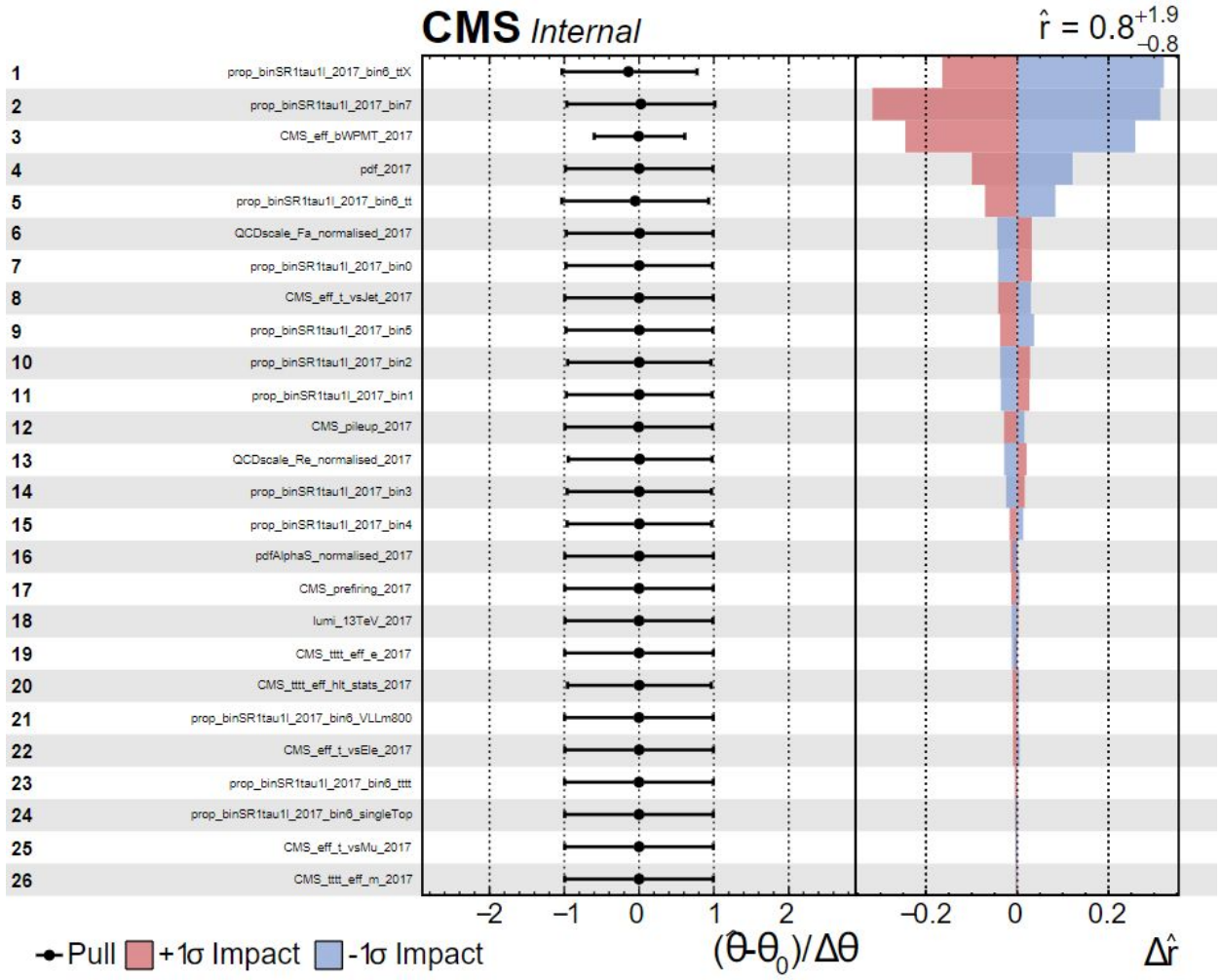
SR

limit: 3.95

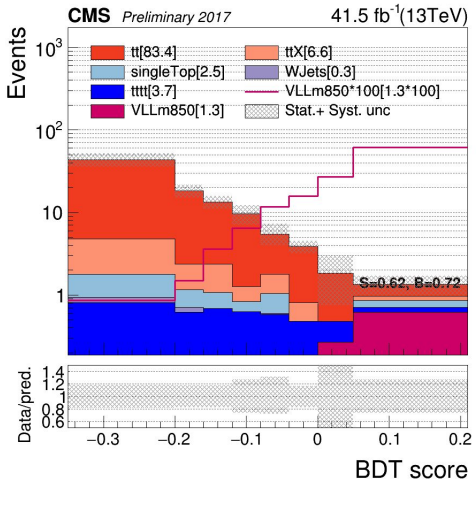
significance: 0.70

CR1

CR2


CMS Internal
$\hat{r} = 0.8^{+1.9}_{-0.8}$
1 prop_binSR1tau1l_2017_bin6_ttX
2 prop_binSR1tau1l_2017_bin7
3 CMS_eff_bWPMT_2017
4 pdf_2017
5 prop_binSR1tau1l_2017_bin6_tt
6 QCDscale_Fa_normalised_2017
7 prop_binSR1tau1l_2017_bin0
8 CMS_eff_t_vsJet_2017
9 prop_binSR1tau1l_2017_bin5
10 prop_binSR1tau1l_2017_bin2
11 prop_binSR1tau1l_2017_bin1
12 CMS_pileup_2017
13 QCDscale_Re_normalised_2017
14 prop_binSR1tau1l_2017_bin3
15 prop_binSR1tau1l_2017_bin4
16 pdfAlphaS_normalised_2017
17 CMS_prefiring_2017
18 lumi_13TeV_2017
19 CMS_tttt_eff_e_2017
20 CMS_tttt_eff_hlt_stats_2017
21 prop_binSR1tau1l_2017_bin6_VLLm800
22 CMS_eff_t_vsEle_2017
23 prop_binSR1tau1l_2017_bin6_tttt
24 prop_binSR1tau1l_2017_bin6_singleTop
25 CMS_eff_t_vsMu_2017
26 CMS_tttt_eff_m_2017
−2 −1 0 1 2
−0.2 0 0.2
Pull
+1σ Impact
-1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

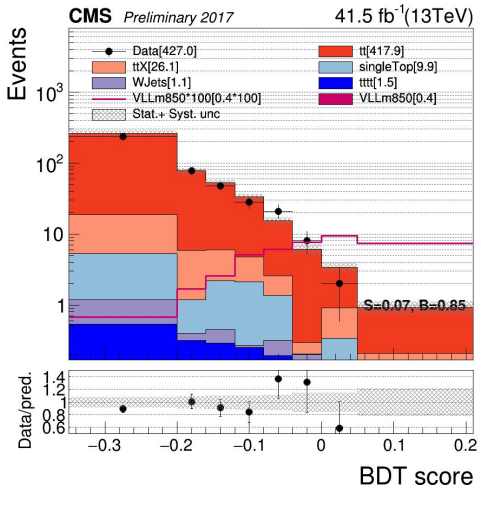
VLLm850 best bin(last bin: 0.05-0.2)



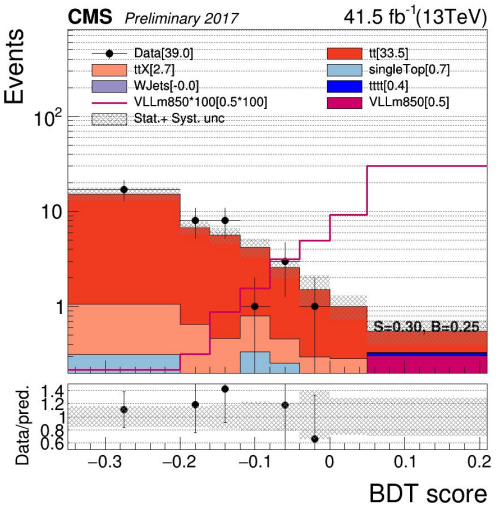
SR

limit: 4.80

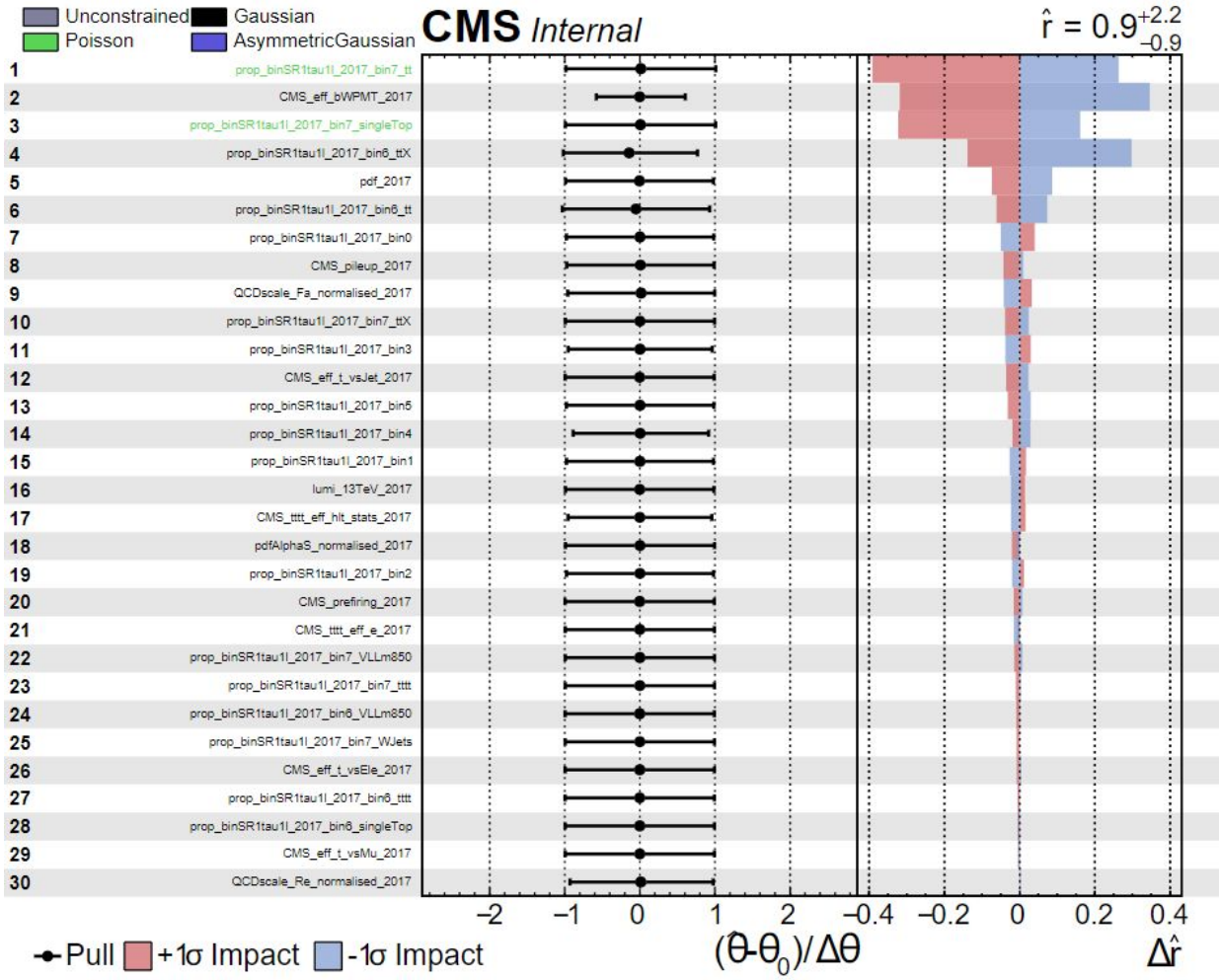
significance: 0.61



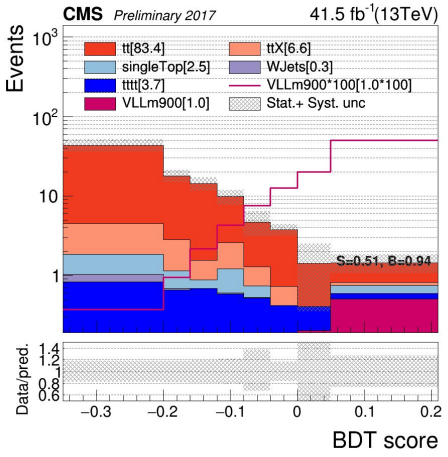
CR1



CR2


Unconstrained
Gaussian
Poisson
AsymmetricGaussian
CMS Internal
r̂ = 0.9 +2.2 −0.9
1 prop_binSR1tau1l_2017_bin7_tt
2 CMS_eff_bWPMT_2017
3 prop_binSR1tau1l_2017_bin7_singleTop
4 prop_binSR1tau1l_2017_bin6_ttX
5 pdf_2017
6 prop_binSR1tau1l_2017_bin6_tt
7 prop_binSR1tau1l_2017_bin0
8 CMS_pileup_2017
9 QCDscale_Fa_normalised_2017
10 prop_binSR1tau1l_2017_bin7_ttX
11 prop_binSR1tau1l_2017_bin3
12 CMS_eff_t_vsJet_2017
13 prop_binSR1tau1l_2017_bin5
14 prop_binSR1tau1l_2017_bin4
15 prop_binSR1tau1l_2017_bin1
16 lumi_13TeV_2017
17 CMS_tttt_eff_hlt_stats_2017
18 pdfAlphaS_normalised_2017
19 prop_binSR1tau1l_2017_bin2
20 CMS_prefiring_2017
21 CMS_tttt_eff_e_2017
22 prop_binSR1tau1l_2017_bin7_VLLm850
23 prop_binSR1tau1l_2017_bin7_tttt
24 prop_binSR1tau1l_2017_bin6_VLLm850
25 prop_binSR1tau1l_2017_bin7_WJets
26 CMS_eff_t_vsEle_2017
27 prop_binSR1tau1l_2017_bin6_tttt
28 prop_binSR1tau1l_2017_bin6_singleTop
29 CMS_eff_t_vsMu_2017
30 QCDscale_Re_normalised_2017
−2 −1 0 1 2
−0.4 −0.2 0 0.2 0.4
Pull
+1σ Impact
-1σ Impact
(θ-θ0)/Δθ
Δr̂

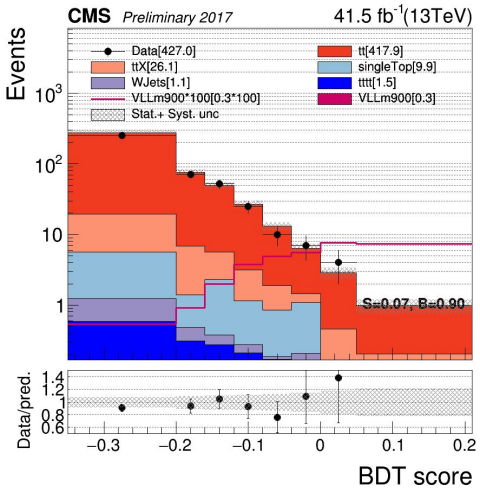
VLLm900 best bin(last bin: 0.05-0.2)



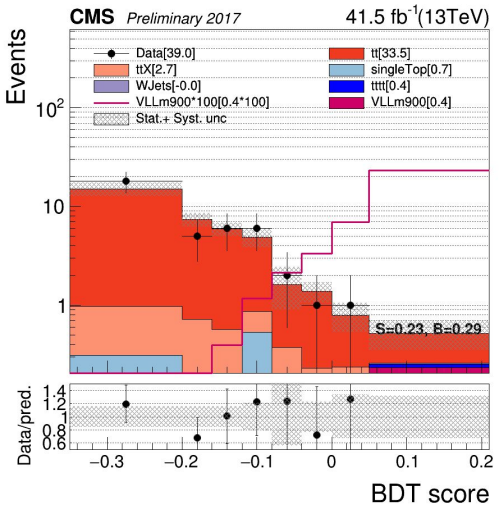
SR

limit: 6.34

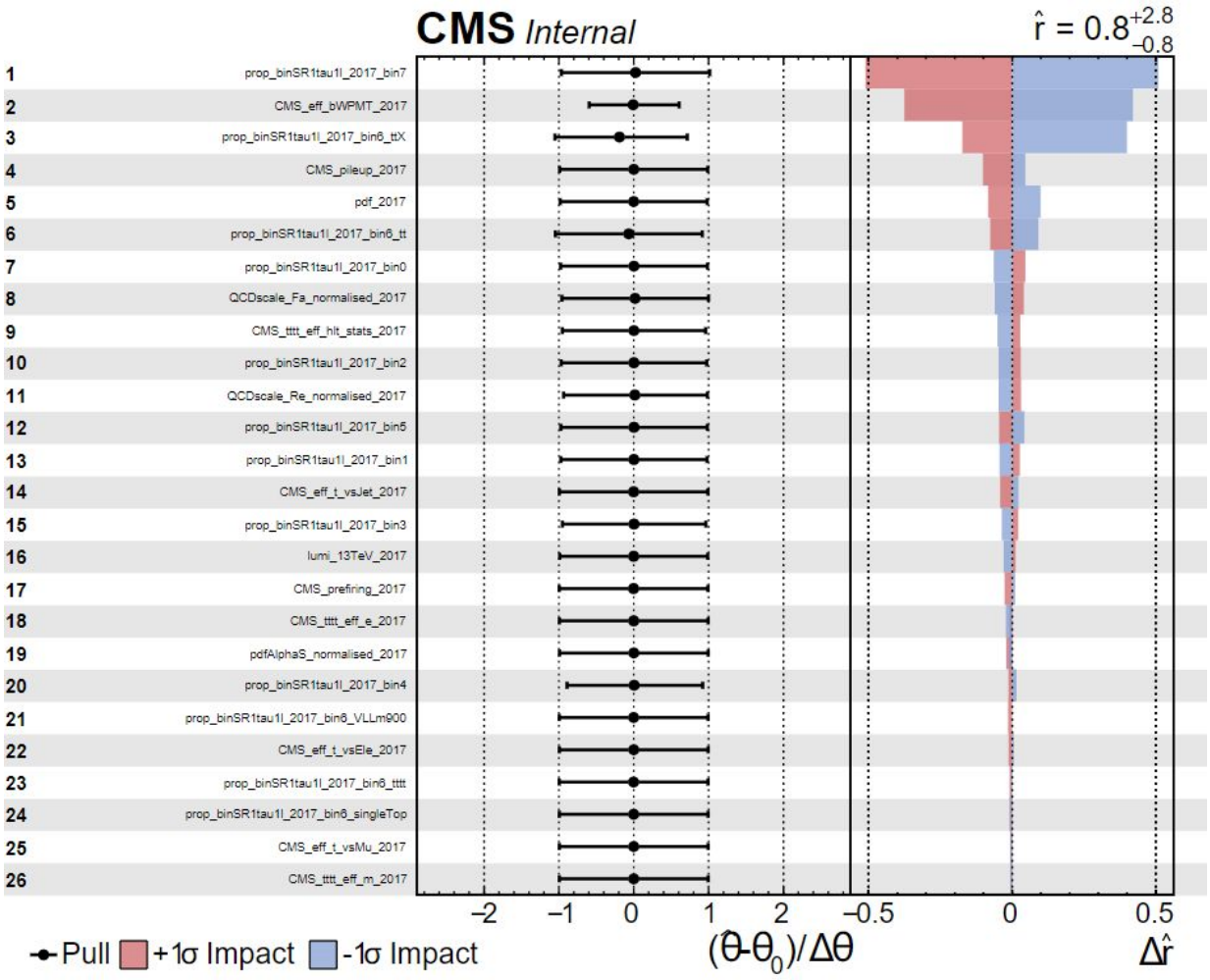
significance: 0.47



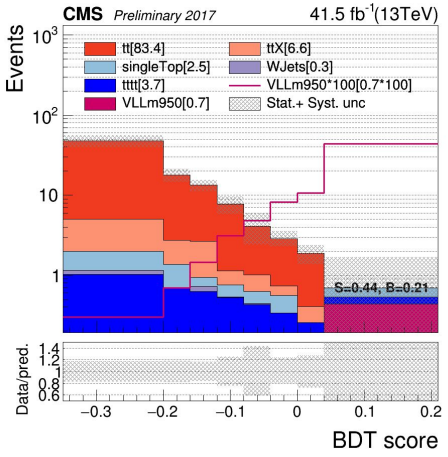
CR1

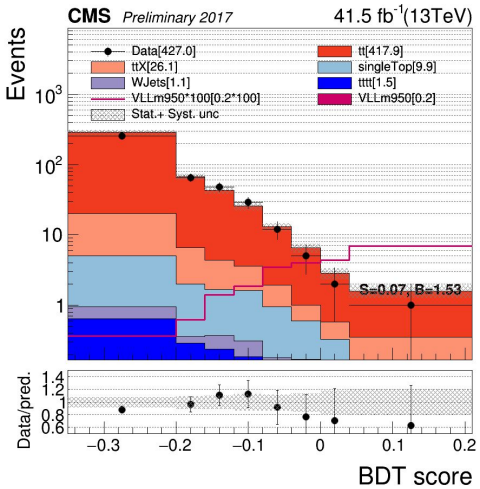


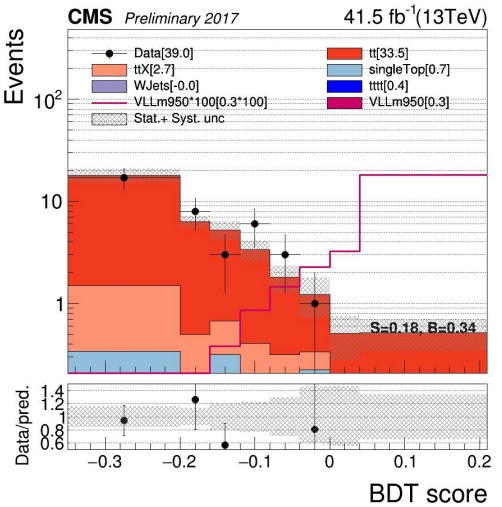
CR2


CMS Internal
$\hat{r} = 0.8^{+2.8}_{-0.8}$
1 prop_binSR1tau1l_2017_bin7
2 CMS_eff_bWPMT_2017
3 prop_binSR1tau1l_2017_bin6_ttX
4 CMS_pileup_2017
5 pdf_2017
6 prop_binSR1tau1l_2017_bin6_tt
7 prop_binSR1tau1l_2017_bin0
8 QCDscale_Fa_normalised_2017
9 CMS_tttt_eff_hlt_stats_2017
10 prop_binSR1tau1l_2017_bin2
11 QCDscale_Re_normalised_2017
12 prop_binSR1tau1l_2017_bin5
13 prop_binSR1tau1l_2017_bin1
14 CMS_eff_t_vsJet_2017
15 prop_binSR1tau1l_2017_bin3
16 lumi_13TeV_2017
17 CMS_prefiring_2017
18 CMS_tttt_eff_e_2017
19 pdfAlphaS_normalised_2017
20 prop_binSR1tau1l_2017_bin4
21 prop_binSR1tau1l_2017_bin6_VLLm900
22 CMS_eff_t_vsEle_2017
23 prop_binSR1tau1l_2017_bin6_tttt
24 prop_binSR1tau1l_2017_bin6_singleTop
25 CMS_eff_t_vsMu_2017
26 CMS_tttt_eff_m_2017
−2 −1 0 1 2
−0.5 0 0.5
Pull +1σ Impact -1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

VLLm950 best bin(last bin: 0.04-0.2)







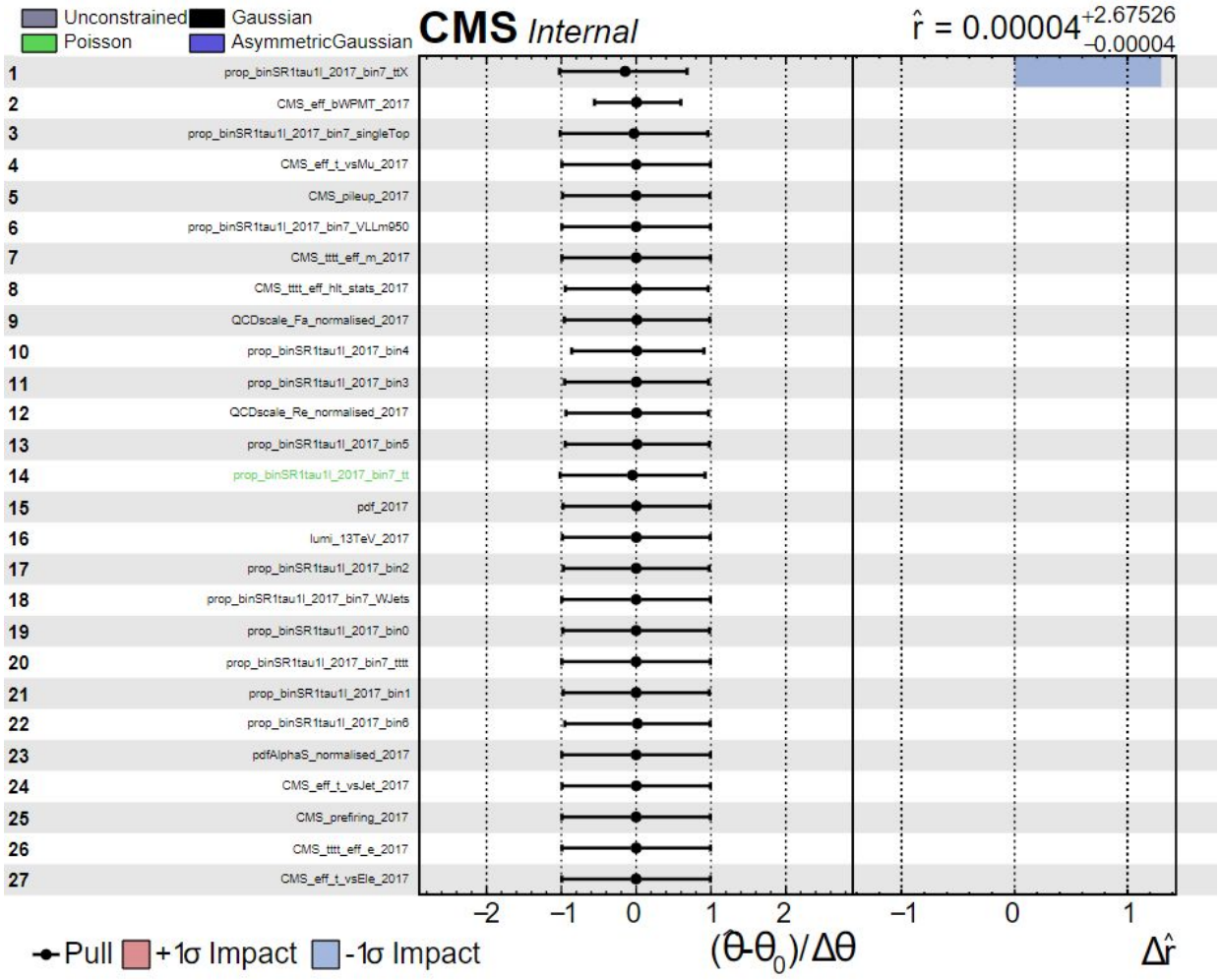
SR

limit: 8.15

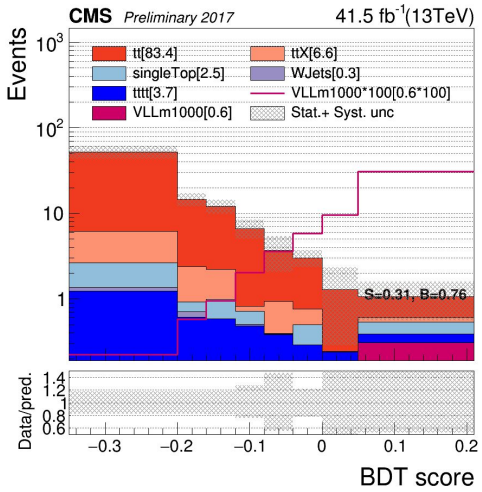
significance: 0.32

CR1

CR2


Unconstrained
Gaussian
Poisson
AsymmetricGaussian
CMS Internal
r̂ = 0.00004 +2.67526 −0.00004
1 prop_binSR1tau1l_2017_bin7_ttX
2 CMS_eff_bWPMT_2017
3 prop_binSR1tau1l_2017_bin7_singleTop
4 CMS_eff_t_vsMu_2017
5 CMS_pileup_2017
6 prop_binSR1tau1l_2017_bin7_VLLm950
7 CMS_tttt_eff_m_2017
8 CMS_tttt_eff_hlt_stats_2017
9 QCDscale_Fa_normalised_2017
10 prop_binSR1tau1l_2017_bin4
11 prop_binSR1tau1l_2017_bin3
12 QCDscale_Re_normalised_2017
13 prop_binSR1tau1l_2017_bin5
14 prop_binSR1tau1l_2017_bin7_tt
15 pdf_2017
16 lumi_13TeV_2017
17 prop_binSR1tau1l_2017_bin2
18 prop_binSR1tau1l_2017_bin7_WJets
19 prop_binSR1tau1l_2017_bin0
20 prop_binSR1tau1l_2017_bin7_tttt
21 prop_binSR1tau1l_2017_bin1
22 prop_binSR1tau1l_2017_bin6
23 pdfAlphaS_normalised_2017
24 CMS_eff_t_vsJet_2017
25 CMS_prefiring_2017
26 CMS_tttt_eff_e_2017
27 CMS_eff_t_vsEle_2017
−2 −1 0 1 2
−1 0 1
Pull +1σ Impact -1σ Impact
(θ̂-θ0)/Δθ
Δr̂

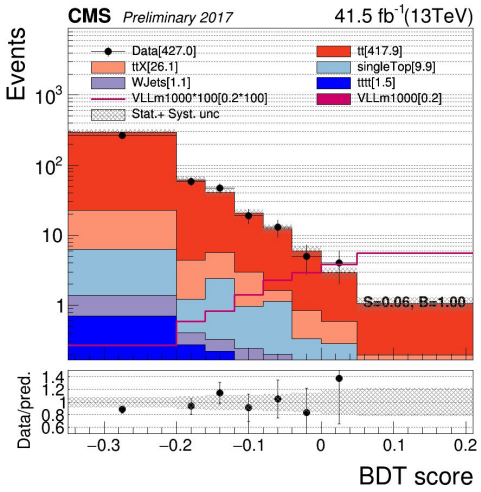
VLLm1000 best bin(last bin: 0.05-0.2)



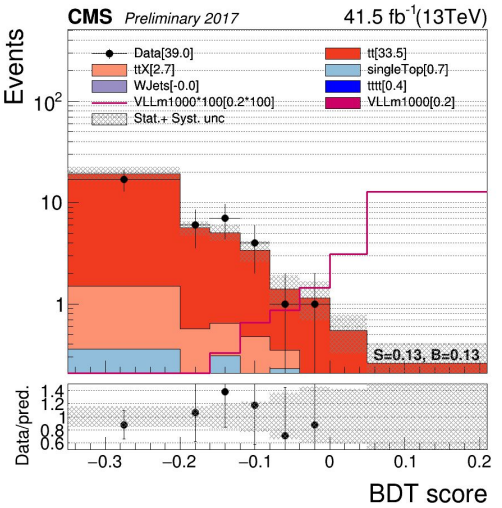
SR

limit: 10.56

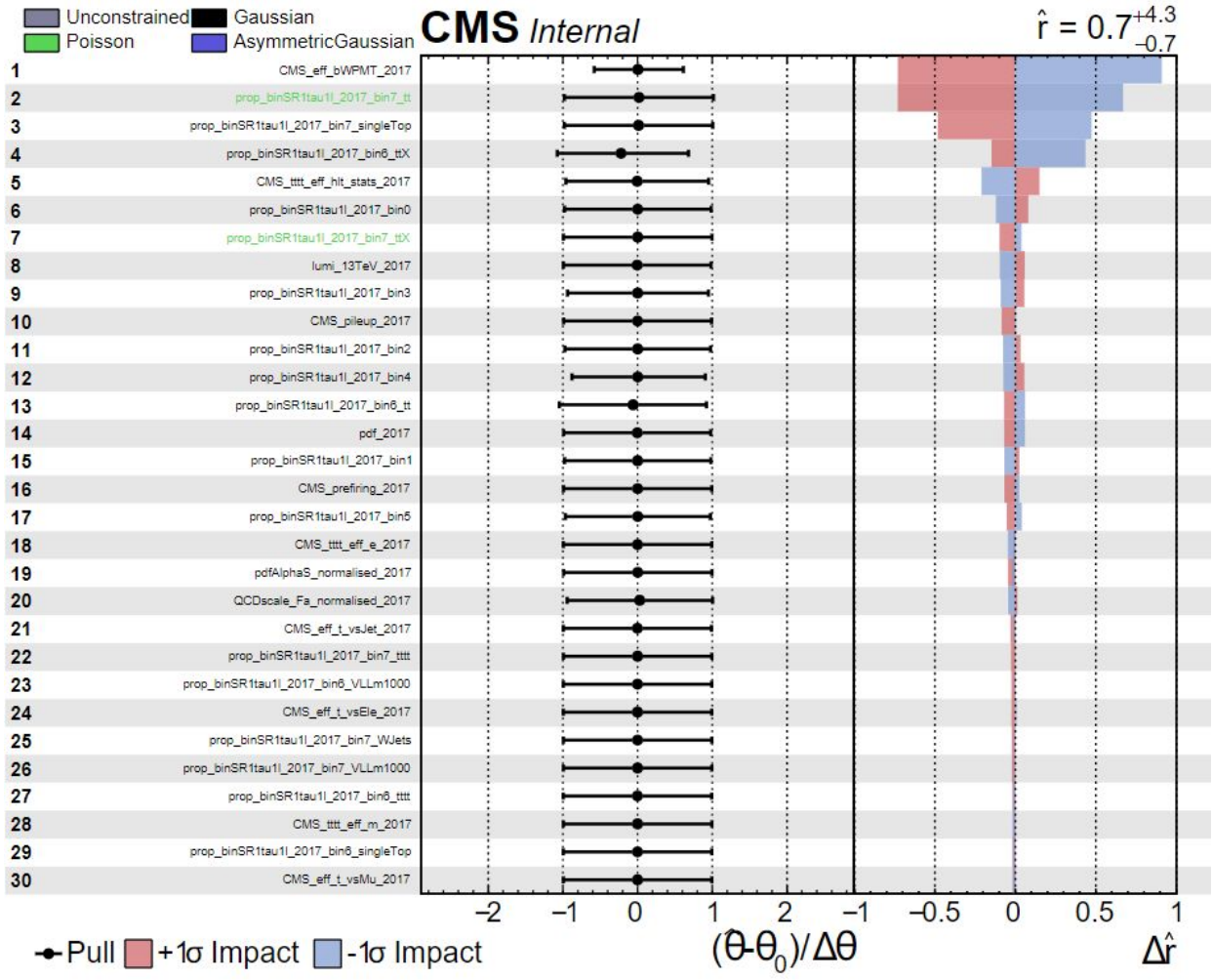
significance: 0.30



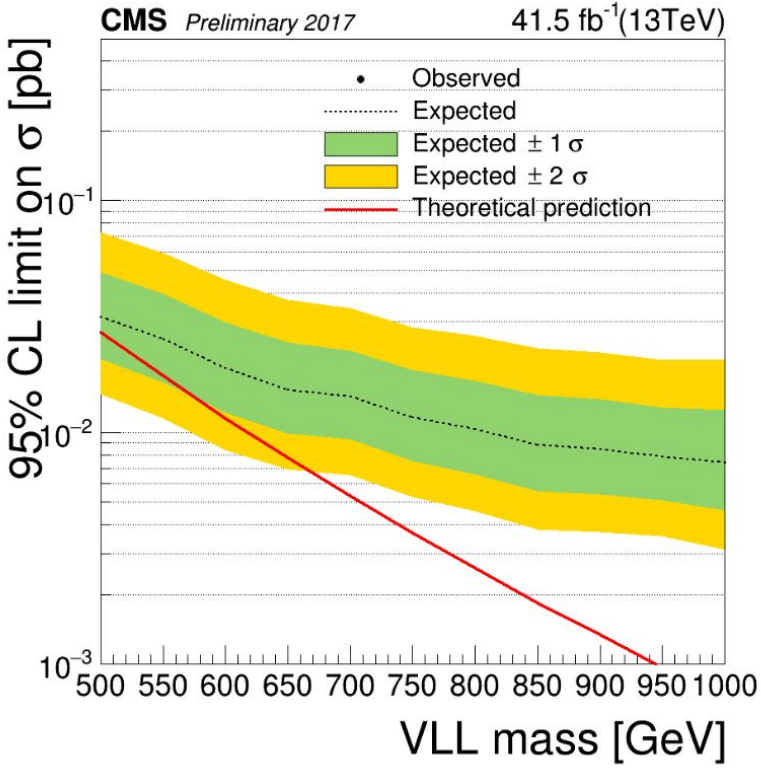
CR1



CR2


Unconstrained
Gaussian
Poisson
AsymmetricGaussian
CMS Internal
$\hat{r} = 0.7^{+4.3}_{-0.7}$
1 CMS_eff_bWPMT_2017
2 prop_binSR1tau1l_2017_bin7_tt
3 prop_binSR1tau1l_2017_bin7_singleTop
4 prop_binSR1tau1l_2017_bin6_ttX
5 CMS_tttt_eff_hlt_stats_2017
6 prop_binSR1tau1l_2017_bin0
7 prop_binSR1tau1l_2017_bin7_ttX
8 lumi_13TeV_2017
9 prop_binSR1tau1l_2017_bin3
10 CMS_pileup_2017
11 prop_binSR1tau1l_2017_bin2
12 prop_binSR1tau1l_2017_bin4
13 prop_binSR1tau1l_2017_bin6_tt
14 pdf_2017
15 prop_binSR1tau1l_2017_bin1
16 CMS_prefiring_2017
17 prop_binSR1tau1l_2017_bin5
18 CMS_tttt_eff_e_2017
19 pdfAlphaS_normalised_2017
20 QCDscale_Fa_normalised_2017
21 CMS_eff_t_vsJet_2017
22 prop_binSR1tau1l_2017_bin7_tttt
23 prop_binSR1tau1l_2017_bin6_VLLm1000
24 CMS_eff_t_vsEle_2017
25 prop_binSR1tau1l_2017_bin7_VJets
26 prop_binSR1tau1l_2017_bin7_VLLm1000
27 prop_binSR1tau1l_2017_bin6_tttt
28 CMS_tttt_eff_m_2017
29 prop_binSR1tau1l_2017_bin6_singleTop
30 CMS_eff_t_vsMu_2017
−2 −1 0 1 2
−1 −0.5 0 0.5 1
Pull
+1σ Impact
-1σ Impact
$(\hat{\theta}-\theta_0)/\Delta\theta$
$\Delta\hat{r}$

mass limit


CMS Preliminary 2017
41.5 fb-1(13TeV)
Observed
Expected
Expected ± 1 σ
Expected ± 2 σ
Theoretical prediction
95% CL limit on σ [pb]
10−1
10−2
10−3
500 550 600 650 700 750 800 850 900 950 1000
VLL mass [GeV]

To do list:

- ❏ Samples list with VLL
- ❏ VLL sample validation: event entries…