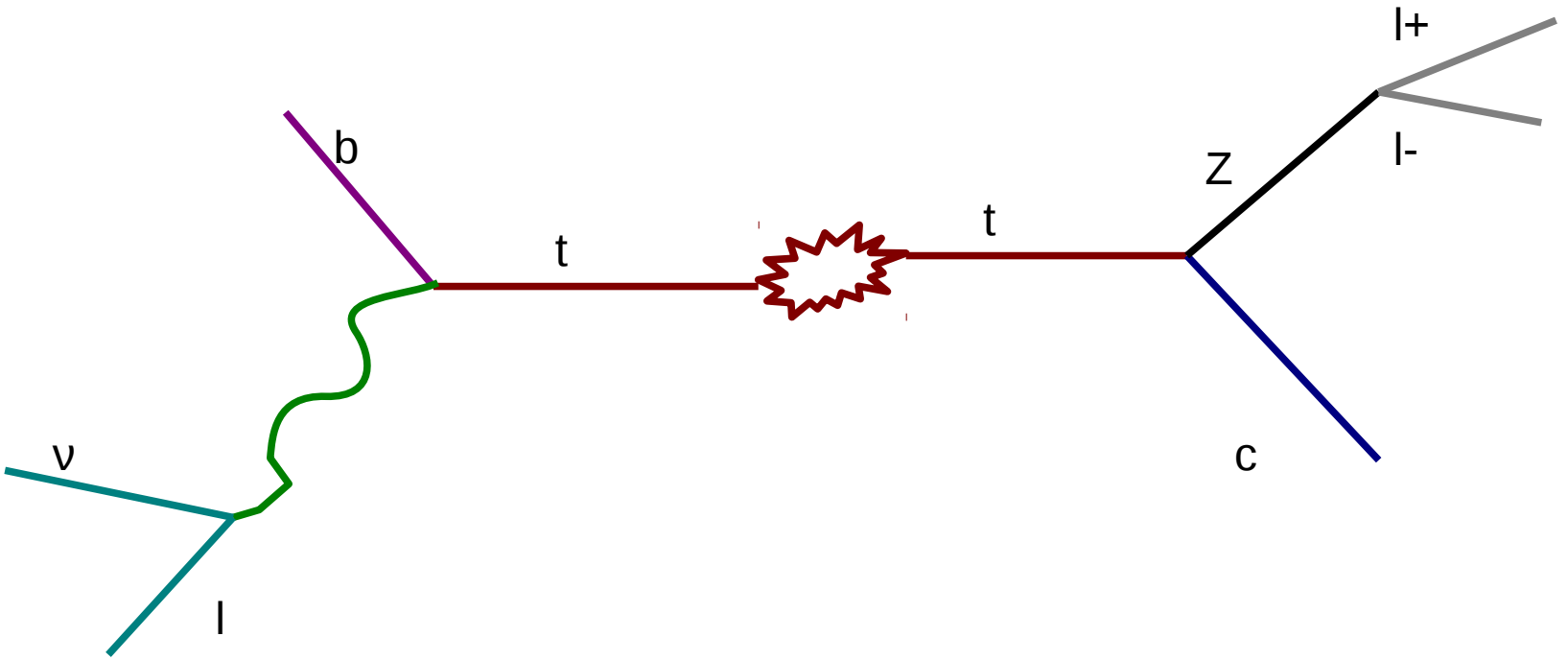
Status of ttbar → 3 leptons



Object selection

Object selection:

- Lepton pt:
  - Electrons and muons: pt > 20 GeV
  - Electrons |eta|: <2.5 en muons |eta|< 2.4
- Jets: pt > 40 , |eta| < 2.4 , EEoverHE() > 0.3
- Cone 04
- B jet discriminator: CSV loose

Cutflow

- Number of jets ≥ 2
- Number of b-jets ≥ 1
- At least 1 OSSF pair
- Z mass window of 15 GeV
- ~~Top mass window of 35 GeV~~ → Able to train on Z+jets and ttdilep

Reconstruction efficiencies:

ε(Z(ll)|MCparticle) = 98%

ε(W(l)|MCparticle) = 90%

ε(b|MCparticle) = 76%

ε(c|MCparticle) = 88%

ε(b&c| Mcparticle) = 79%

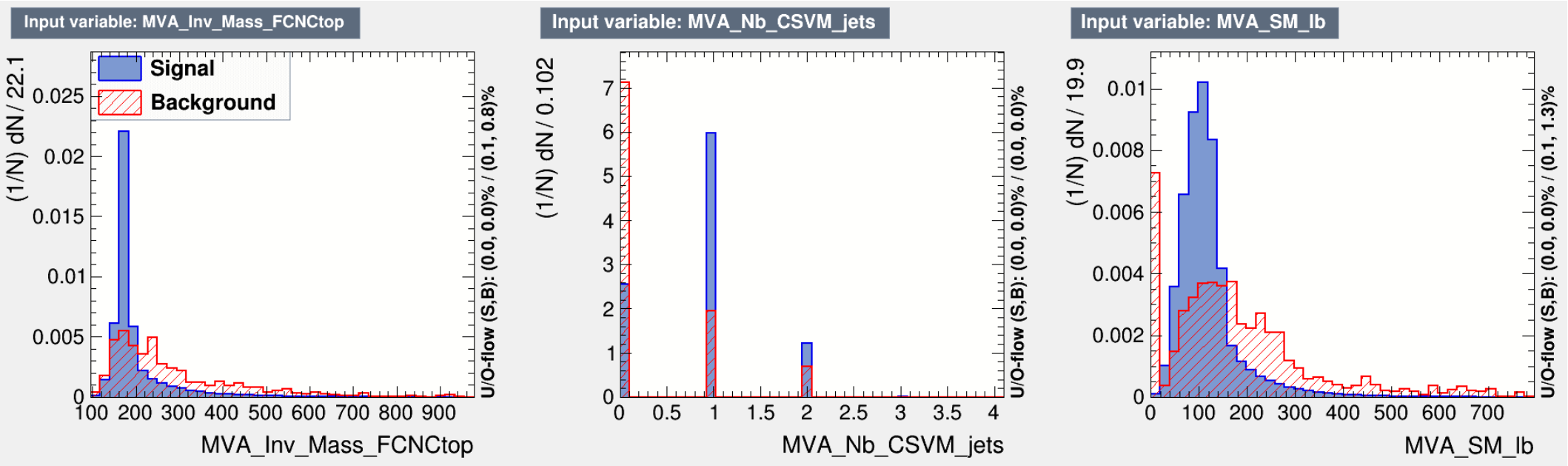
Cutflow with fake leptons:

	Initial	3 leptons	At least 2 jets	At least 1 CSVL	At least 1 OSSF pair	Inv Mass Z
Zct	2.09e+03 ± 0.718	242 ± 0.239	159 ± 0.193	134 ± 0.178	133 ± 0.177	128 ± 0.173
TTdilep WToLNu	1.93e+03 ± 7.6	149 ± 2.11	85 ± 1.6	77.9 ± 1.53	60.1 ± 1.34	14.9 ± 0.669
TTdilep ZToLL	803 ± 2.54	209 ± 1.29	121 ± 0.988	112 ± 0.949	104 ± 0.915	78.1 ± 0.793
TTdilep	6.78e+06 ± 3.44e+03	4.04e+03 ± 82.1	1.41e+03 ± 48.5	1.23e+03 ± 45.2	946 ± 39.7	240 ± 20
TTsemilep HToZZ 2	267 ± 0.34	2.64 ± 0.0339	0.00174 ± 0.00087	0.00174 ± 0.00087	0.00087 ± 0.000615	0.00087 ± 0.000615
TTsemilep ZToLL 1	1.68e+03 ± 5.3	110 ± 1.36	82.8 ± 1.18	73.5 ± 1.11	72 ± 1.1	61.5 ± 1.02
TTsemilep ZToLL 2	1.68e+03 ± 5.3	111 ± 1.37	84.4 ± 1.19	74.4 ± 1.12	72.4 ± 1.1	62.4 ± 1.02
WZToLLLNu	2.57e+05 ± 60.5	1.53e+04 ± 15.5	1.73e+03 ± 5.17	497 ± 2.77	495 ± 2.77	446 ± 2.63
ZToLL50-3Jets	6.28e+06 ± 3.39e+03	3.13e+03 ± 76.1	777 ± 37.9	250 ± 21.5	248 ± 21.4	231 ± 20.7
ZToLL50-4Jets	2.16e+06 ± 1.49e+03	1.66e+03 ± 40.9	959 ± 31.1	323 ± 18	321 ± 18	294 ± 17.2
ZZToLLJJ	2.12e+05 ± 480	83.7 ± 9.54	14.1 ± 3.92	6.53 ± 2.66	6.53 ± 2.66	6.53 ± 2.66
ZZToLLLL	3.59e+04 ± 135	2.75e+03 ± 37.3	181 ± 9.58	51.3 ± 5.1	50.3 ± 5.05	45.7 ± 4.82

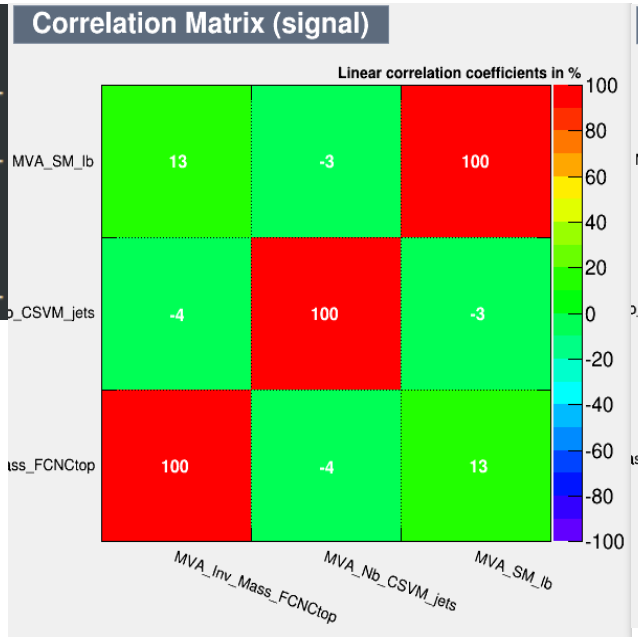
Main backgrounds

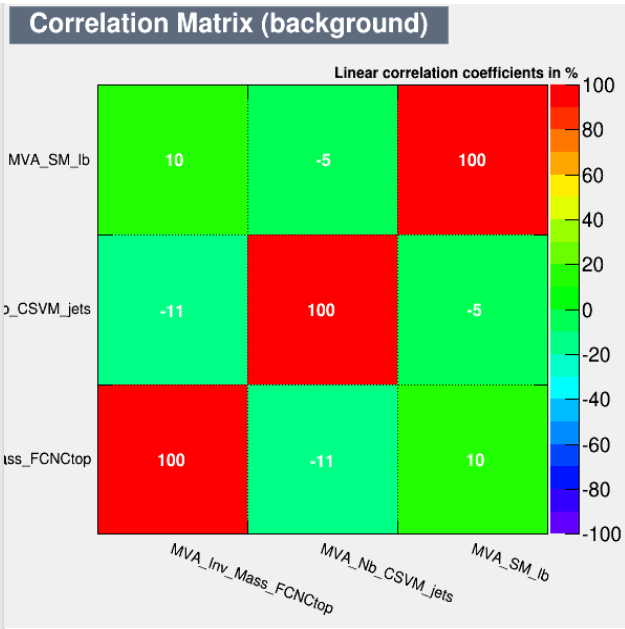
MVA
Cut and Count

MVA: cut and count



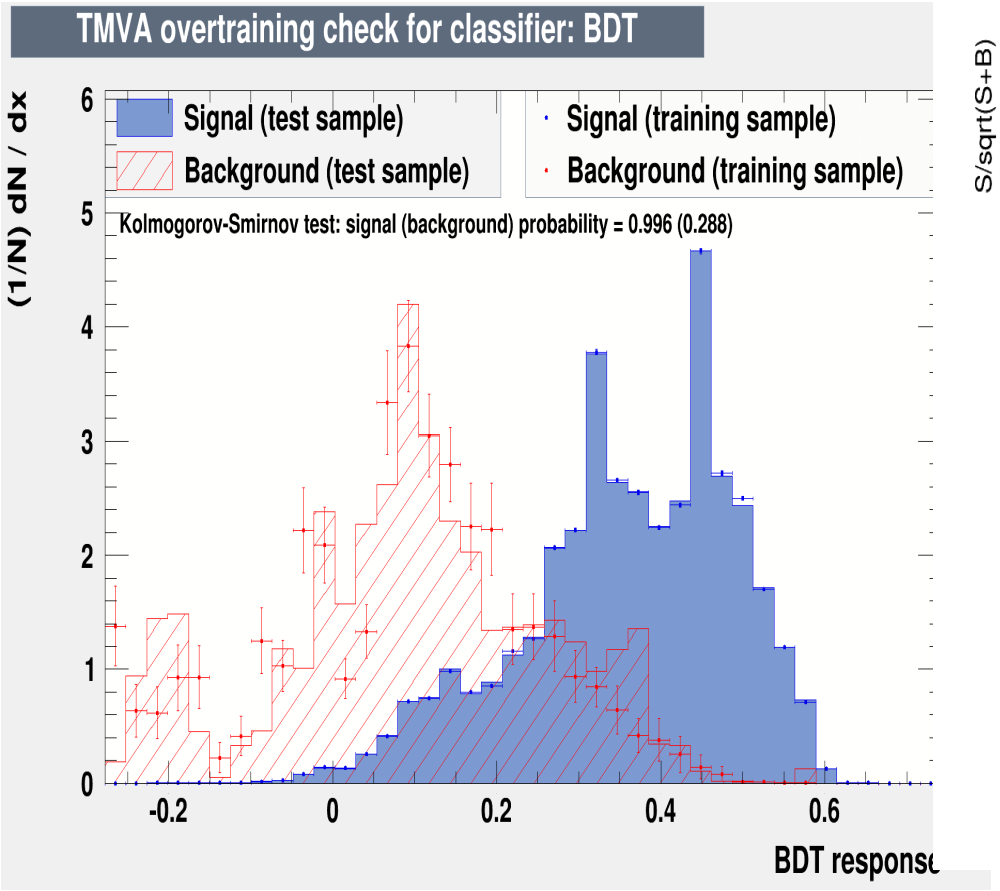

```
Ranking input variables (method specific)...
Ranking result (top variable is best ranked)
-----------------------------------------------------
Rank : Variable            : Variable Importance
-----------------------------------------------------
   1 : MVA_SM_lb           : 3.897e-01
   2 : MVA_Inv_Mass_FCNCtop : 3.372e-01
   3 : MVA_Nb_CSVM_jets     : 2.731e-01
-----------------------------------------------------
```

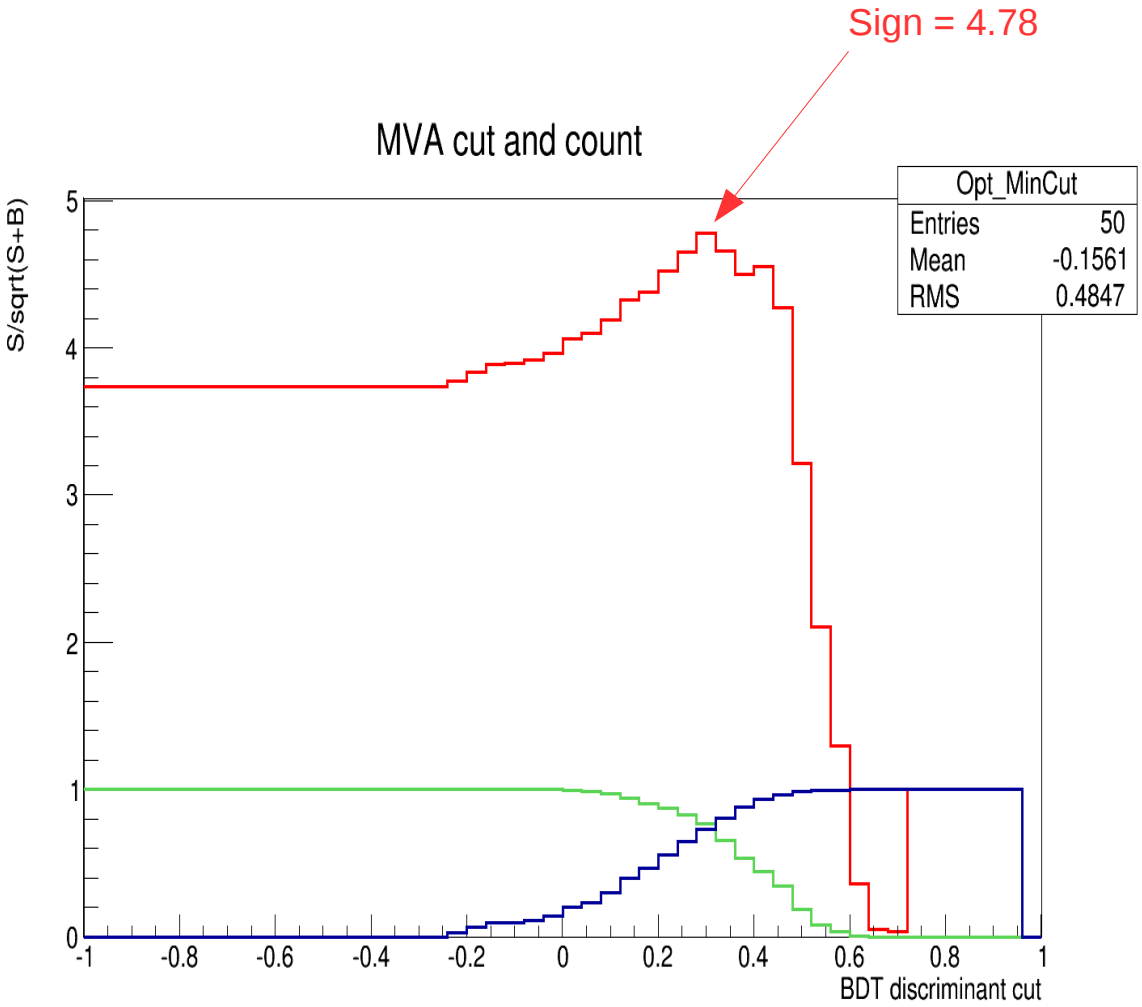




Signal: tcZ
Backgrounds for training: WZ, Z+jets, ttdilep

MVA: cut and count



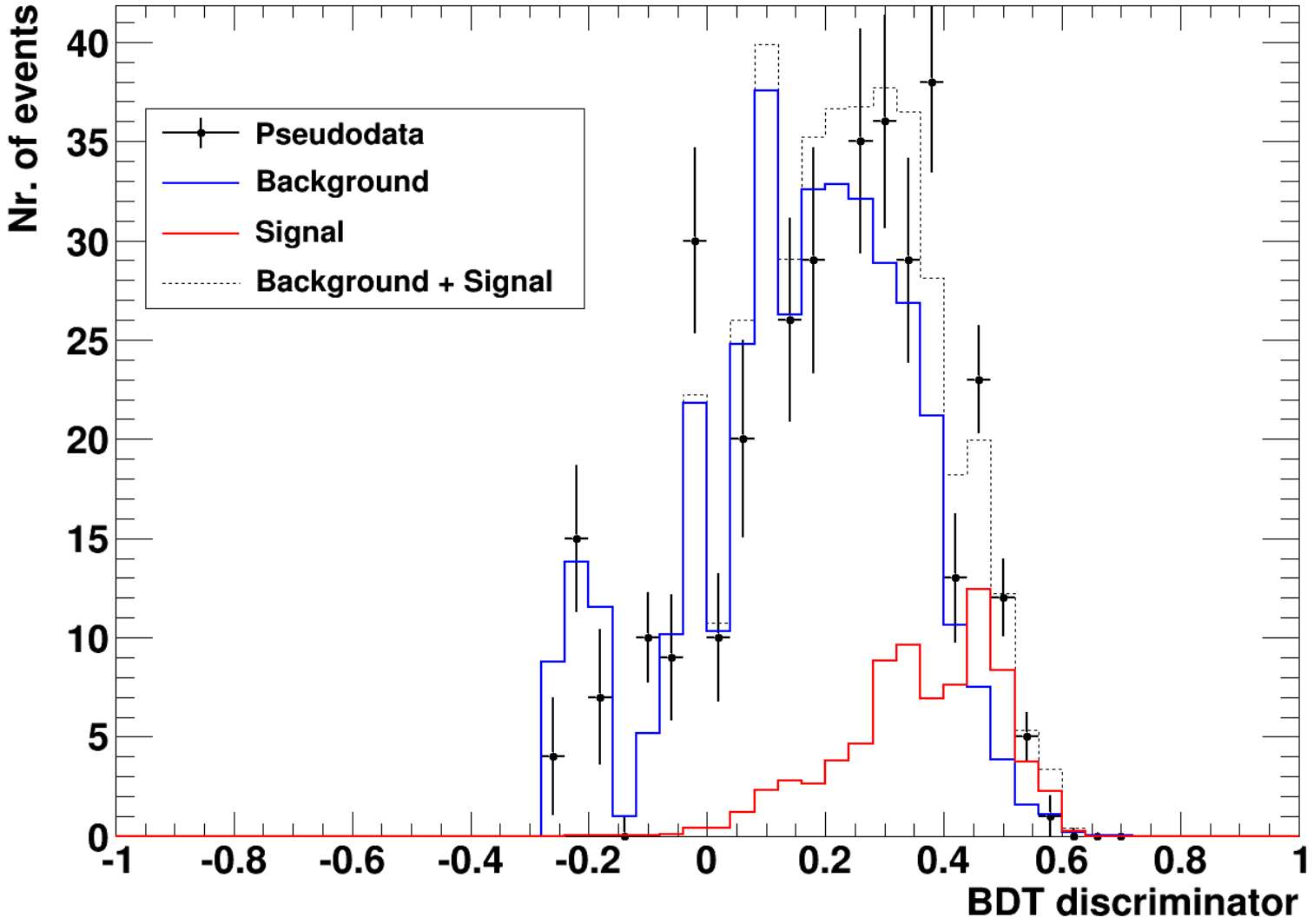


Signal: tcZ
Background for training: WZ, Z+jets, ttdilep
All backgrounds included for significance

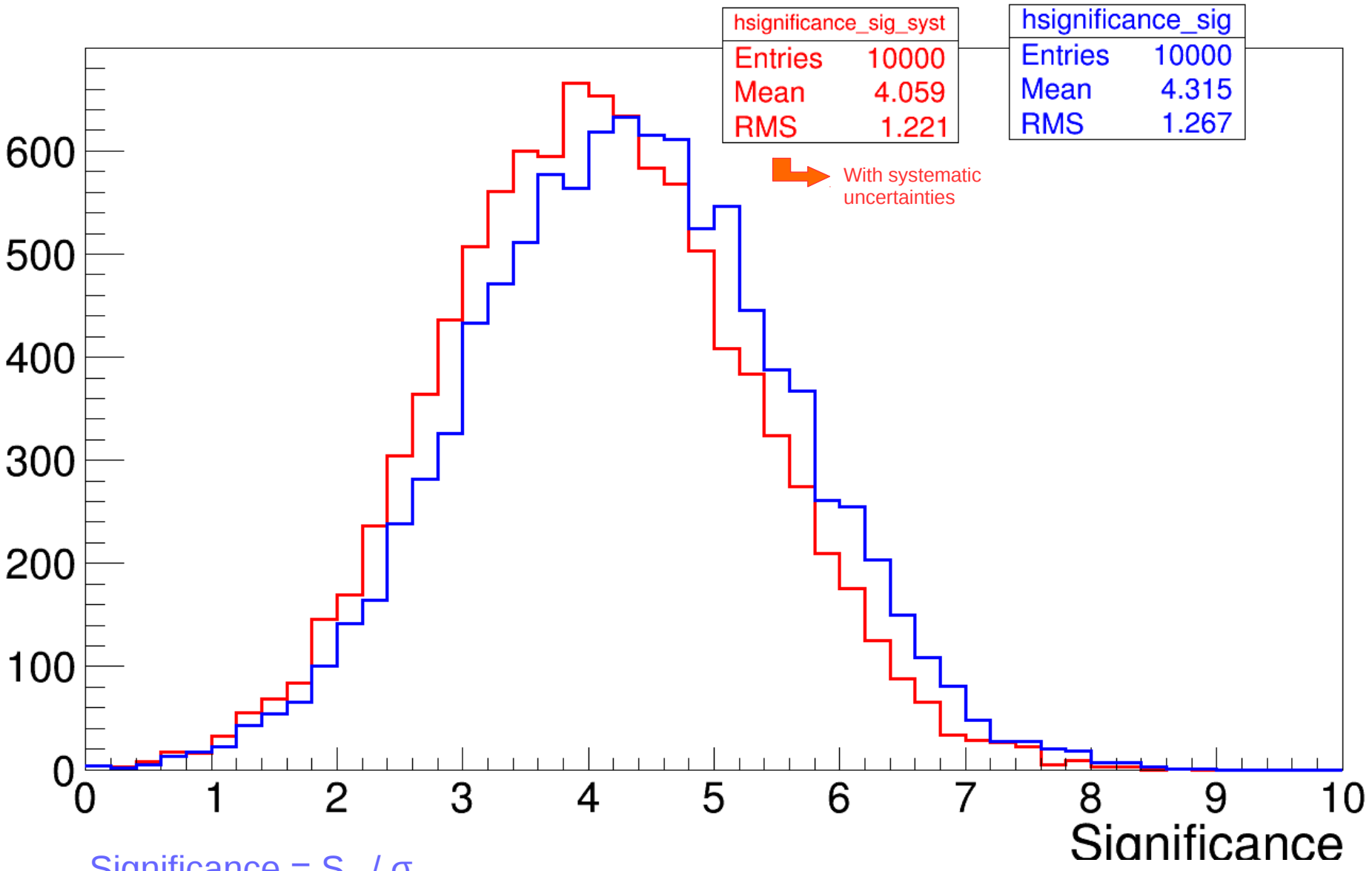
Green: signal efficiency
Blue: background rejection
Red: significance at that lower bound cut

MVA shape analysis

MVA: shape fit

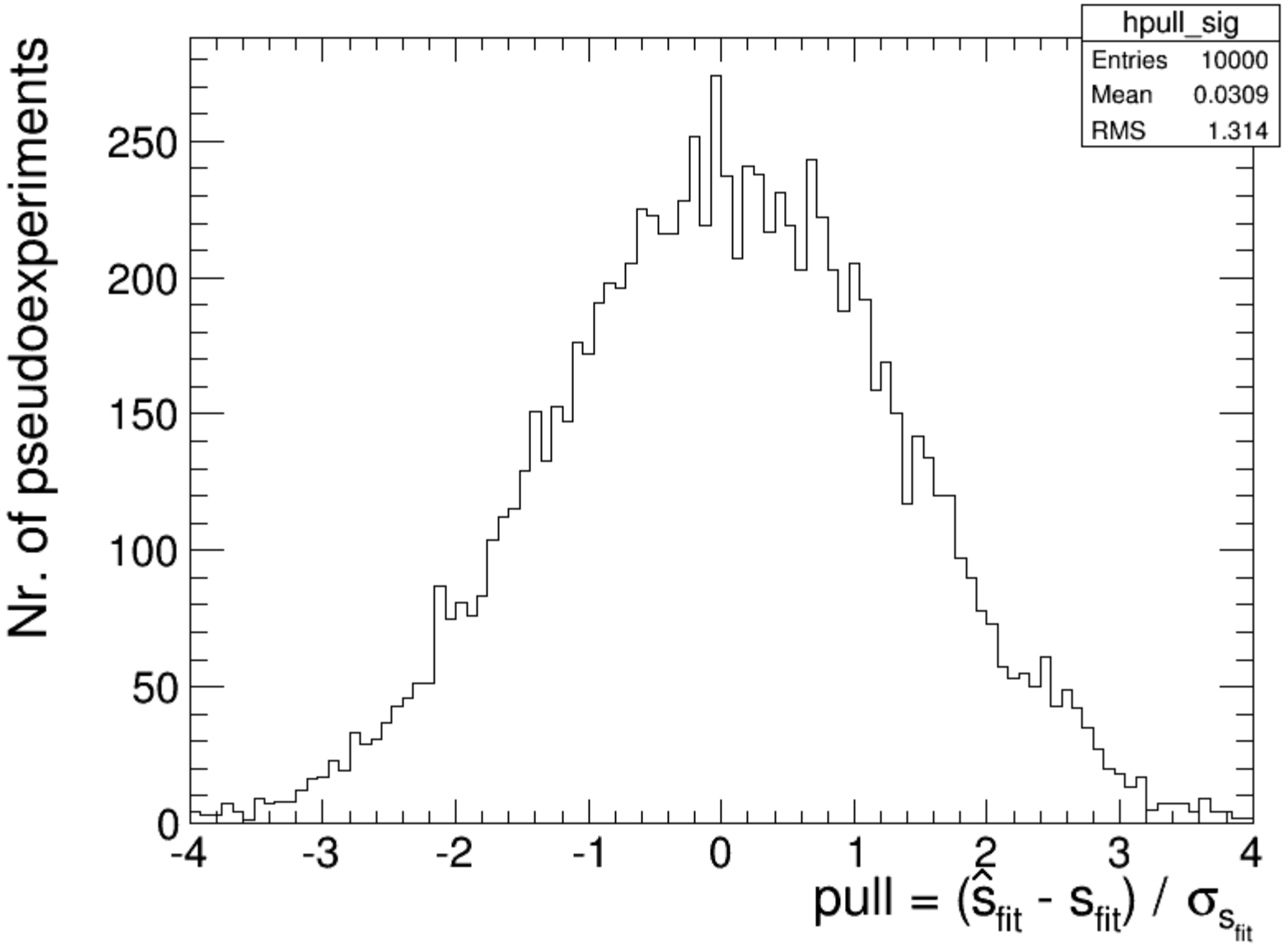


Example of pseudo data



Significance = S_{fit} / σ_{s_fit}

Siginificance = S_{fit} / $\sqrt{[\ (\sigma_{s\_fit})^2 + \sum (\text{syst. shift})^2\ ]}$

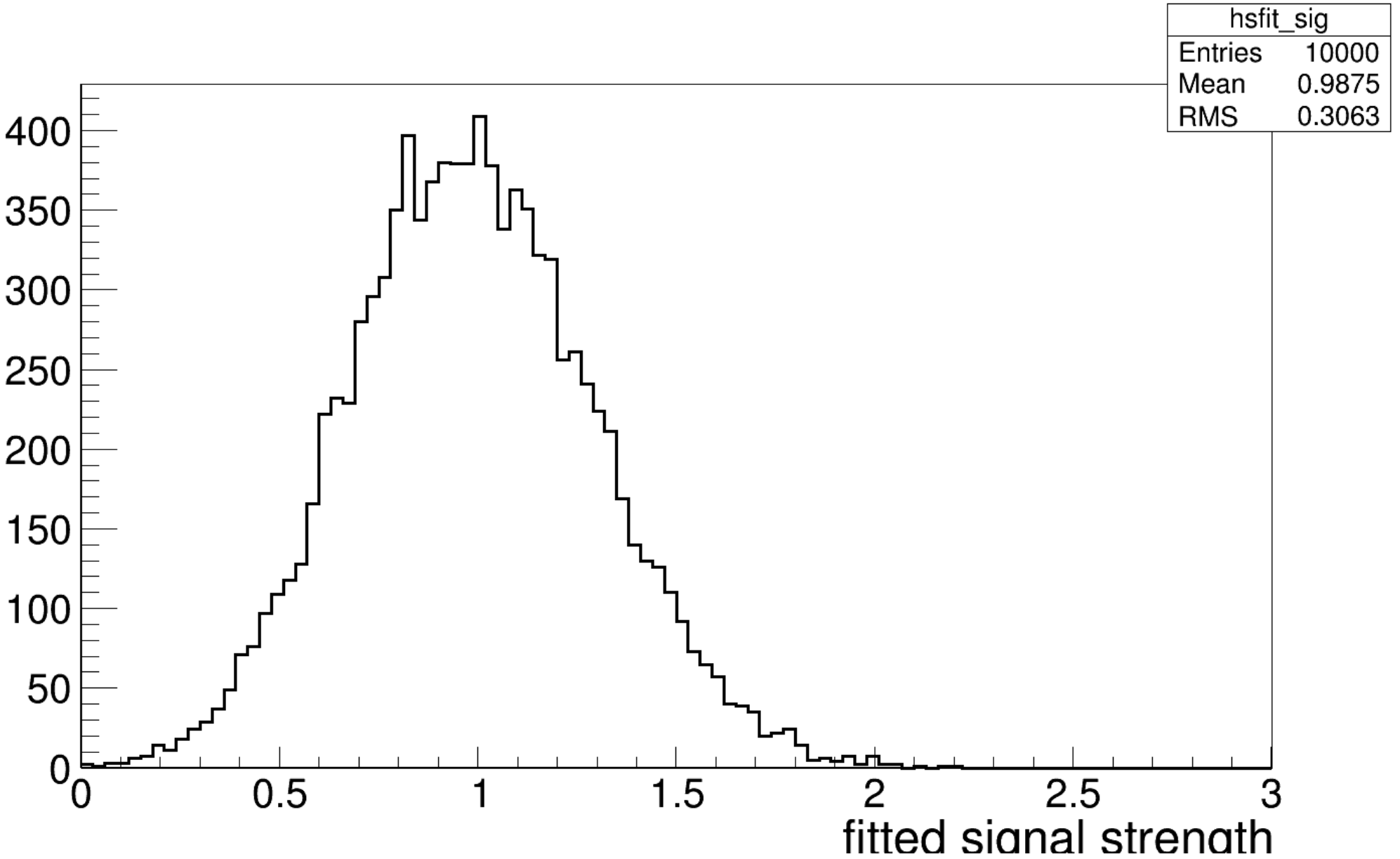


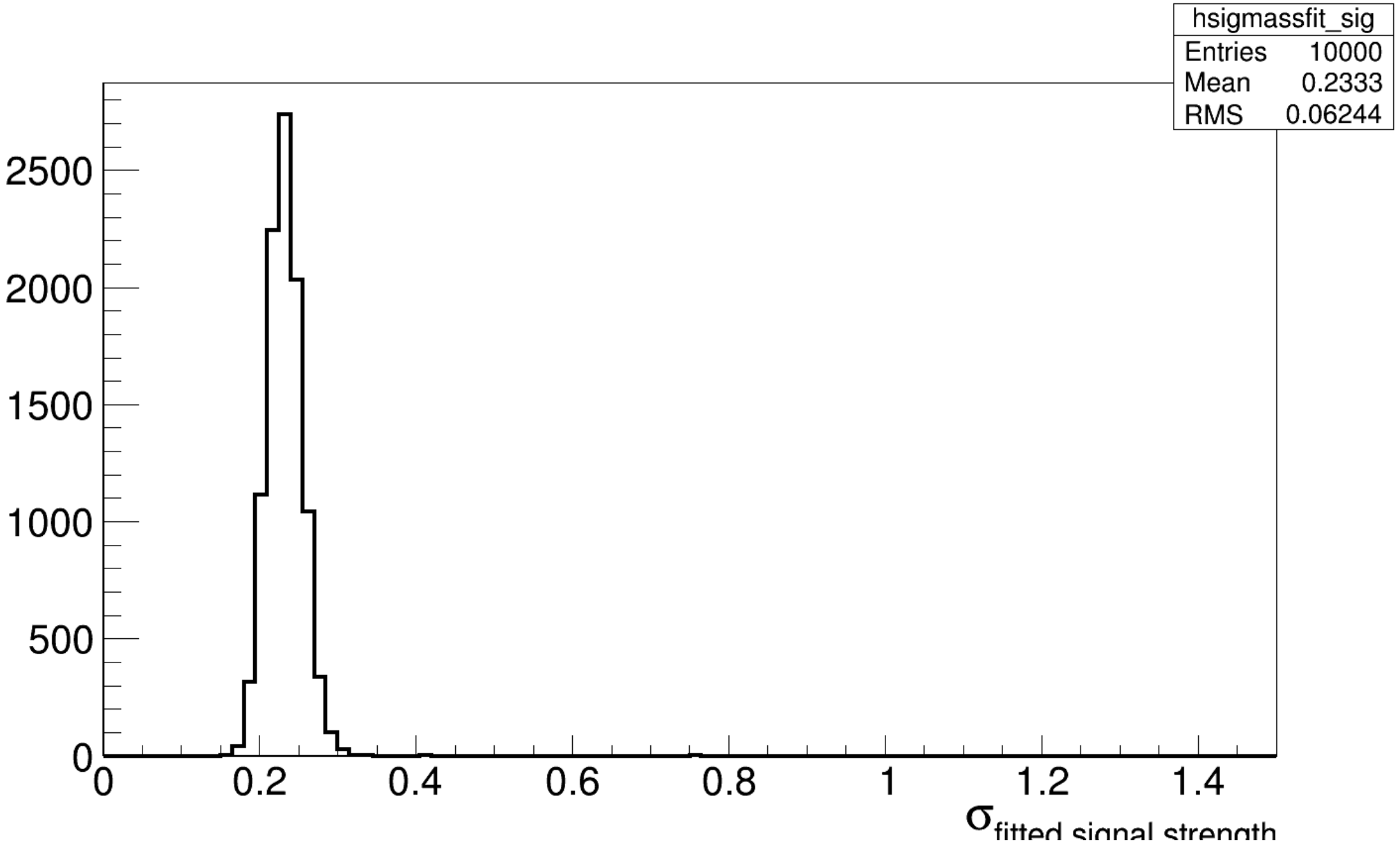
The width of the distribution is a bit larger than one …
Should the uncertainty on the fit be corrected?

	# Signal	# Background	Significance	Significance including systematic uncertainties	comment
Cut and count	128	1481	S/√(S+B) = 3.19	0.67	· Number of jets ≥ 2 · Number of b-jets ≥ 1 · At least 1 OSSF pair · Z mass window of 15 GeV · 50% unc on Xsection of ttdilep · 30% unc on Xsection of WZ · 10% unc on Xsection of Zjets
MVA cut and count	60	98	4.78	2.63	· Trained on WZ (446 evts), Z+jets (525 evts) and ttdilep (240 evts) · On cut: WZ (4 evts), Z+jets (7 evts), ttdilep (32 evts)
MVA fit	128	1481	4.32	4.06	· Trained on WZ (446 evts), Z+jets (525 evts) and ttdilep (240 evts) · Using RooFit · 10 000 pseudo experiments
Kinematic fit **- Inv Mass top fcnc** **- 2d: inv top masses (SM lb vs FCNC llj)** **- 0 CSV M** **- 1 CSV M** **- 2 CSV M**	 128 128 34 79 16	 1481 1481 955 372 152	 2.43 3.19 0.98 3.56 1.40	 2.42 3.18 0.95 3.15 1.32	· Using RooFit · 1000 pseudo experiments

By using a fit, the significance is less influenced by systematic uncertainties

Back up


hsfit_sig
Entries 10000
Mean 0.9875
RMS 0.3063
400
350
300
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
3
fitted signal strength


hsigmassfit_sig
Entries 10000
Mean 0.2333
RMS 0.06244
2500
2000
1500
1000
500
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
σfitted signal strength

Final numbers per # variables (only WZ)

S = 128 B = 446	33 var	30 var	21 var	15 var	13 var	10 var	9 var	8 var	7 var	6 var	5 var	2 var
S/√S+B	8.88	8.88	8.87	8.94	8.87	8.87	8.81	8.84	8.82	8.81	8.74	8.26
Top 3 var	- # CSVM jets - Inv Mass FCNC top - Pt SM b	- # CSVM jets - Inv Mass FCNC top - Pt SM b	- # CSVM jets - Inv Mass FCNC top - DeltaR Bjet Zcan	- #CSVM -Inv Mass FCNC top -Delta R Bjet Zcan	- #CSVM -Inv Mass FCNC top -Delta R Bjet Zcan	- #CSVM -Inv Mass FCNC top -Ht	- #CSVM -Inv Mass FCNC top -Ht	- #CSVM -Inv Mass FCNC top - Tr Mass Wlep,Met, Bjet	- #CSVM -Inv Mass FCNC top - ratio top mass	- #CSVM -Inv Mass FCNC top - Tr Mass Wlep,Met, Bjet	- # CSVM jets - Inv Mass FCNC top - Pt SM b	- #CSVM -Inv Mass FCNC top