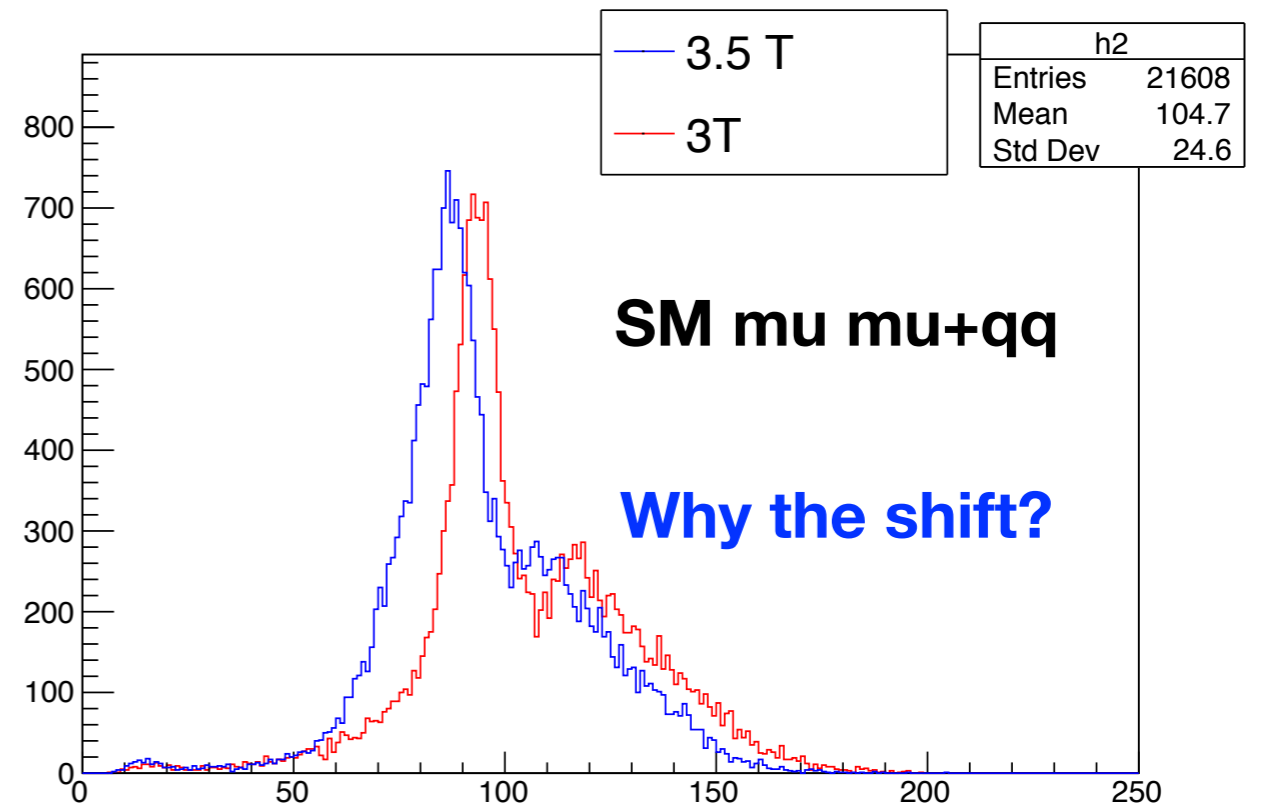
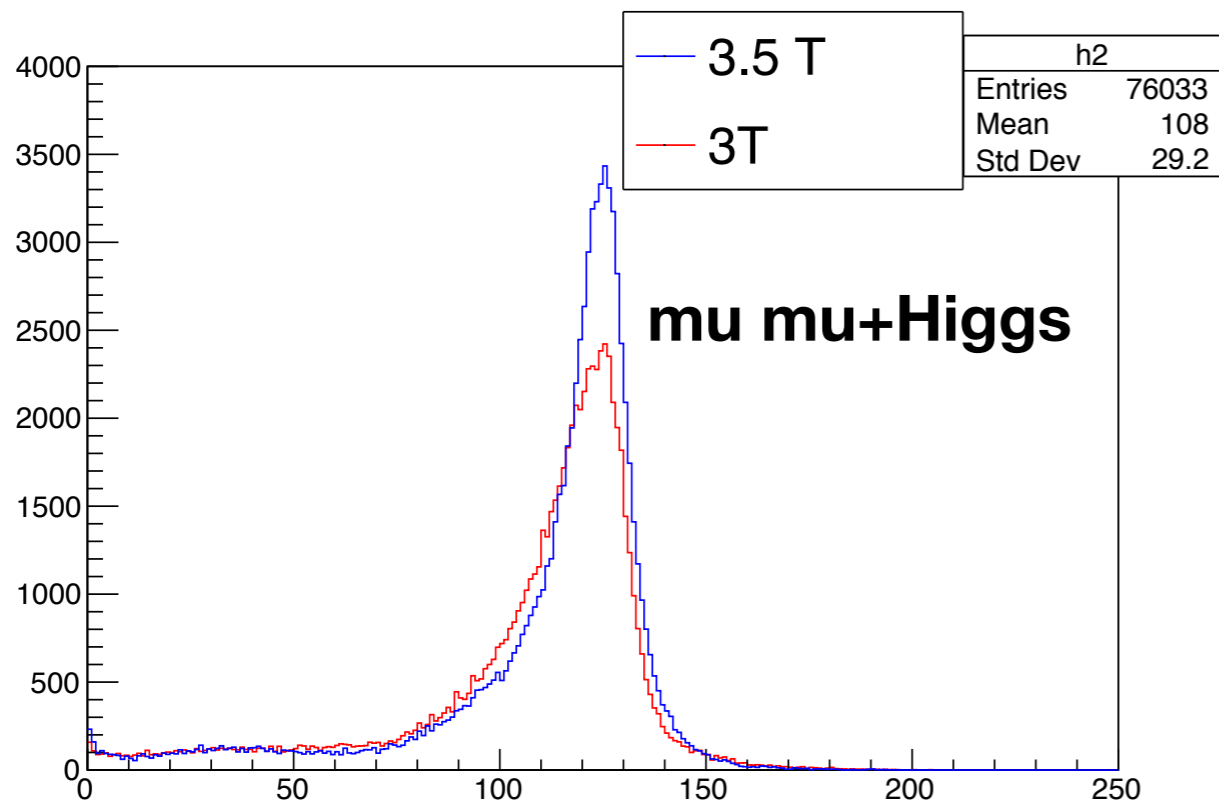


Comparison Between 3T and 3.5T $\mu\mu\mu H \rightarrow \mu\mu\mu$ +bb/cc/gg Analysis

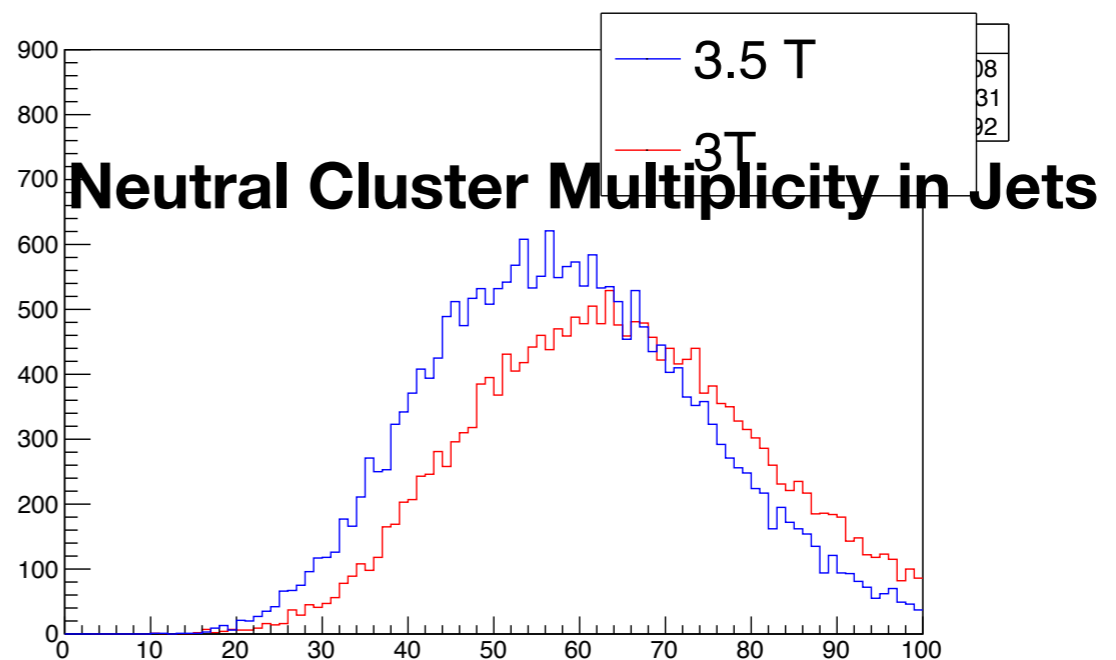
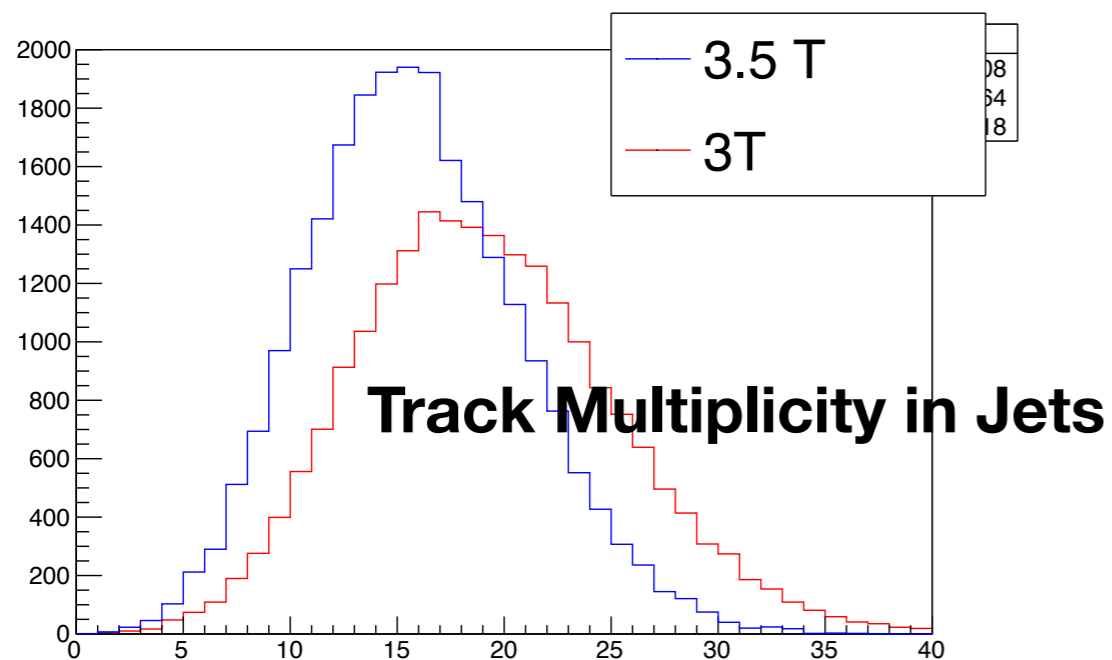
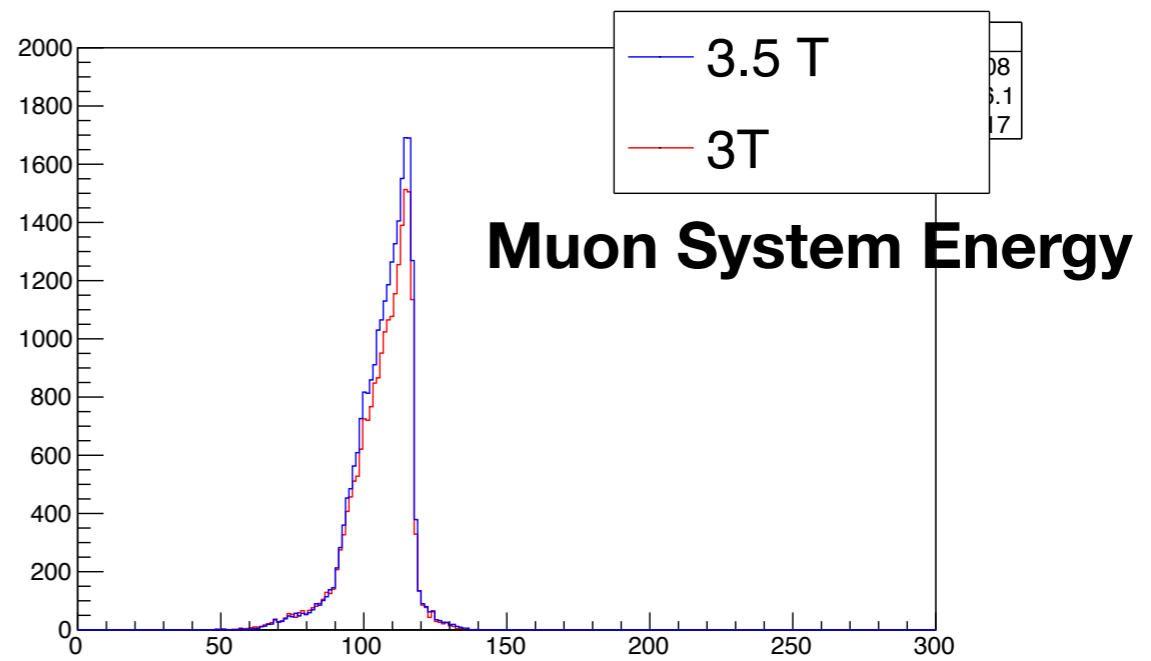
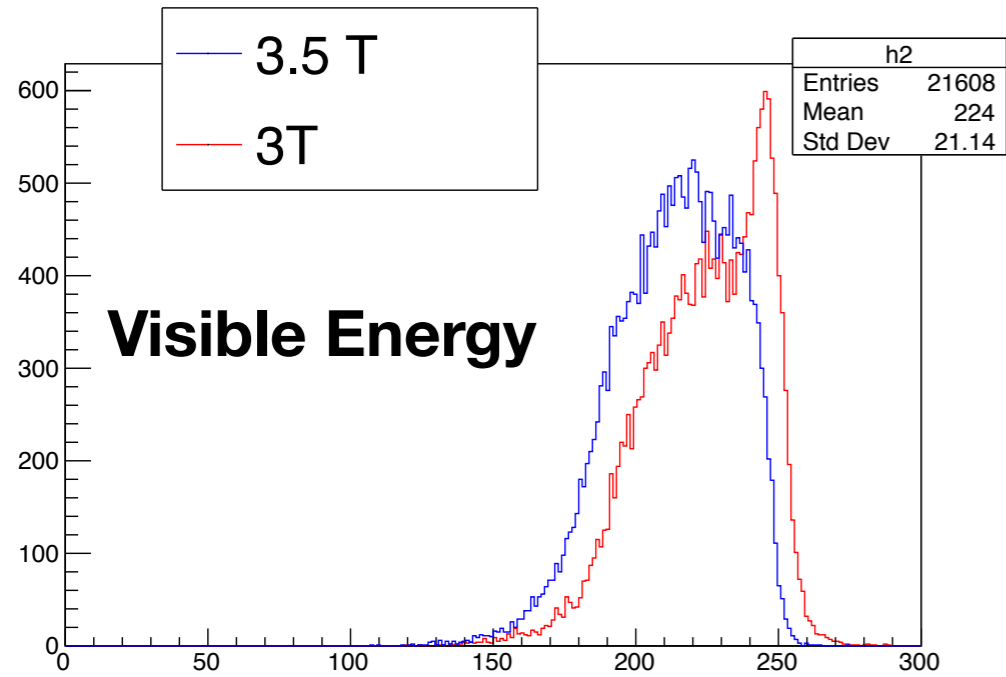
Yu Bai
Southeast University

2018-05-10

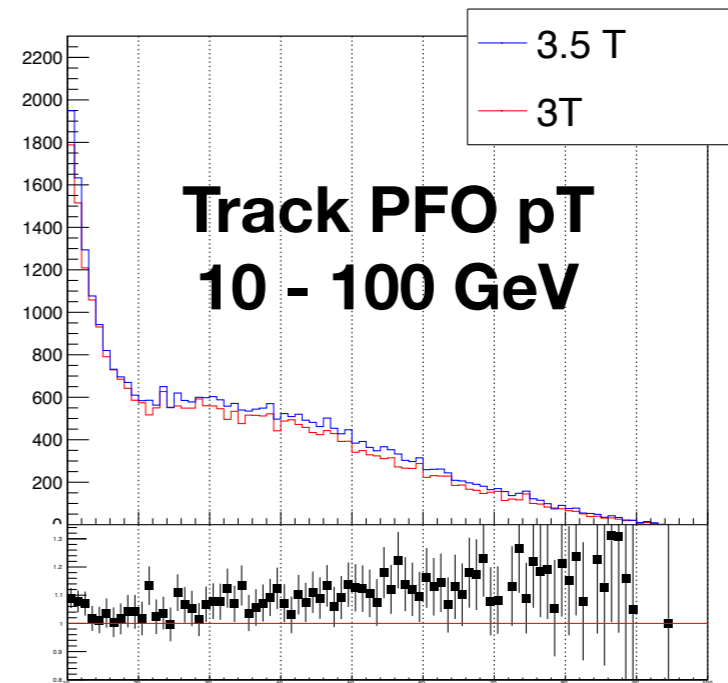
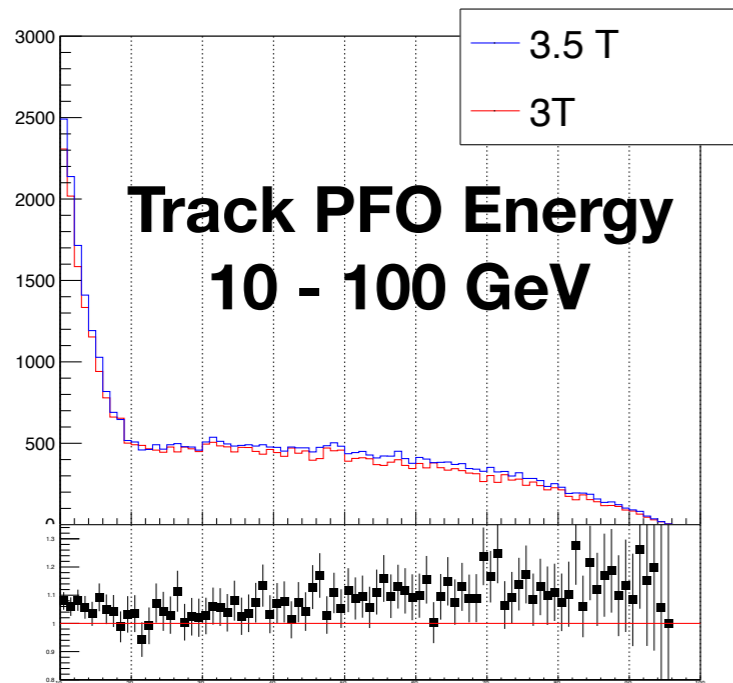
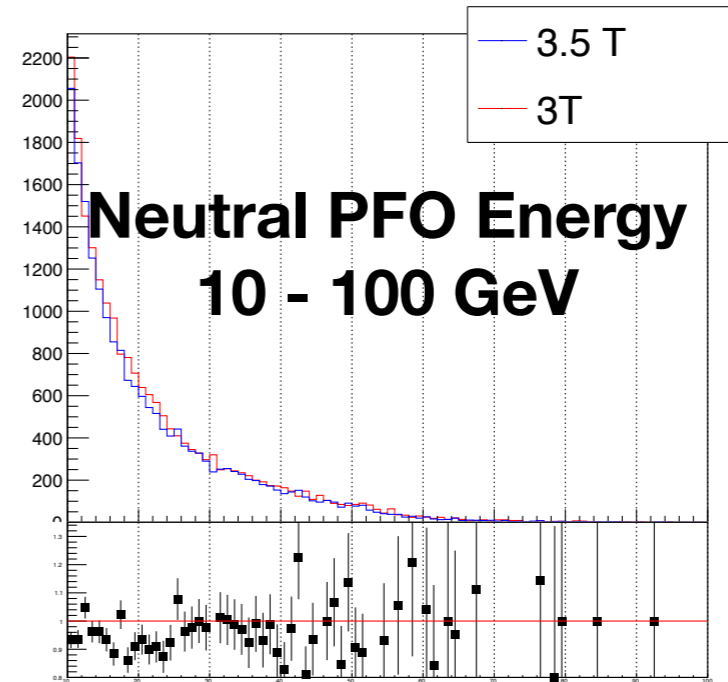
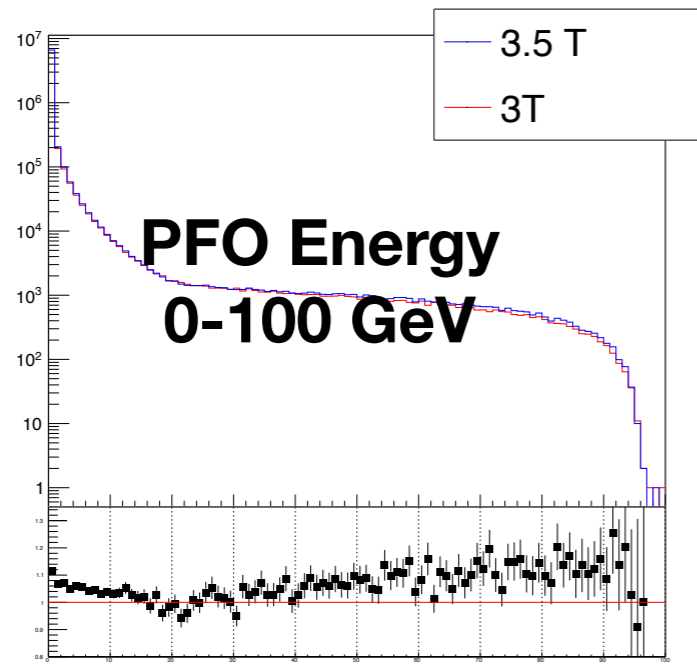
Mjj Distribution



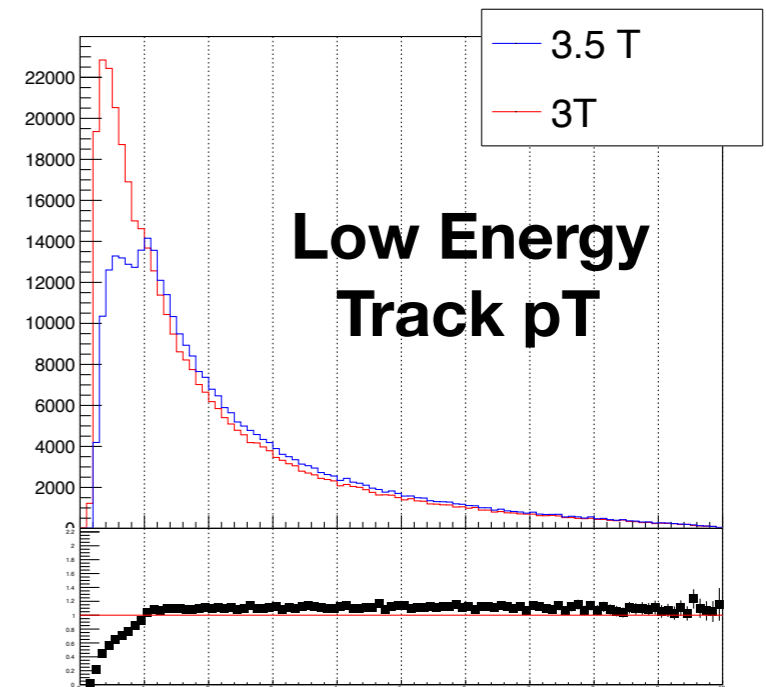
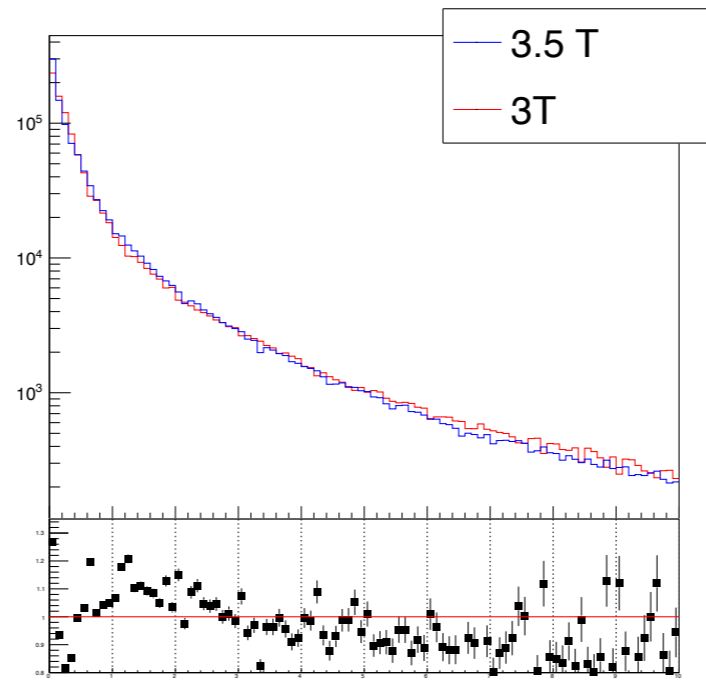
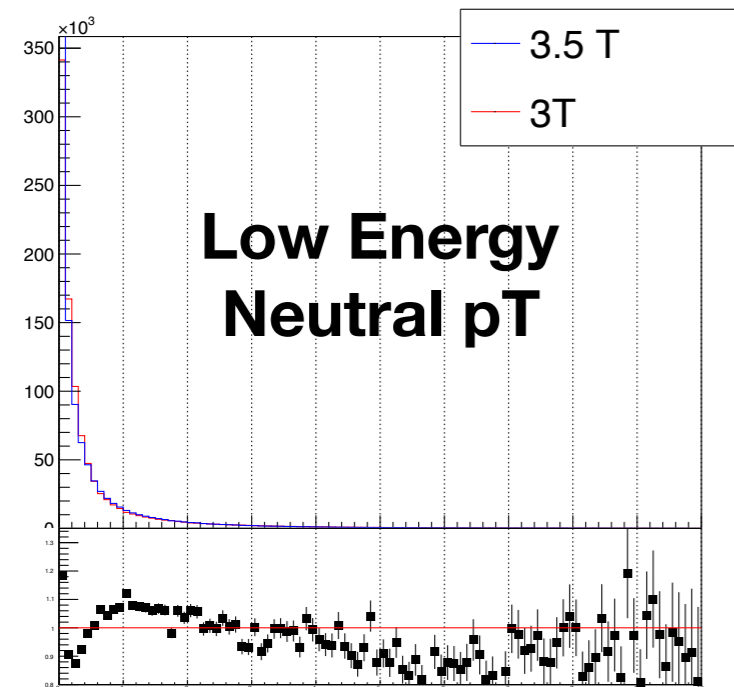
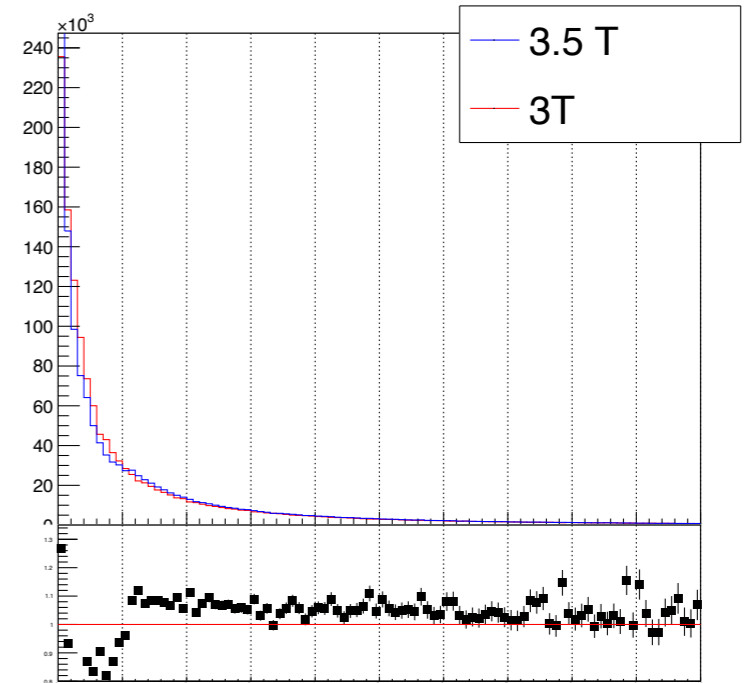
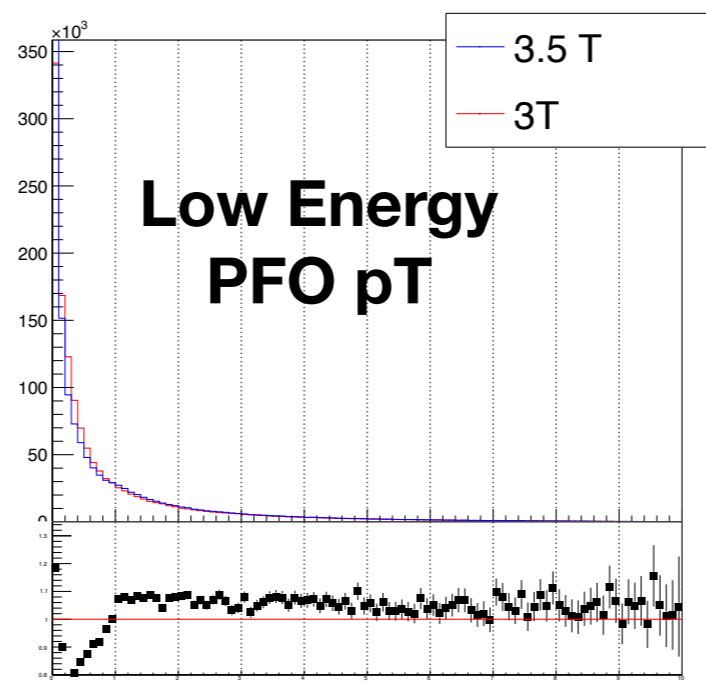
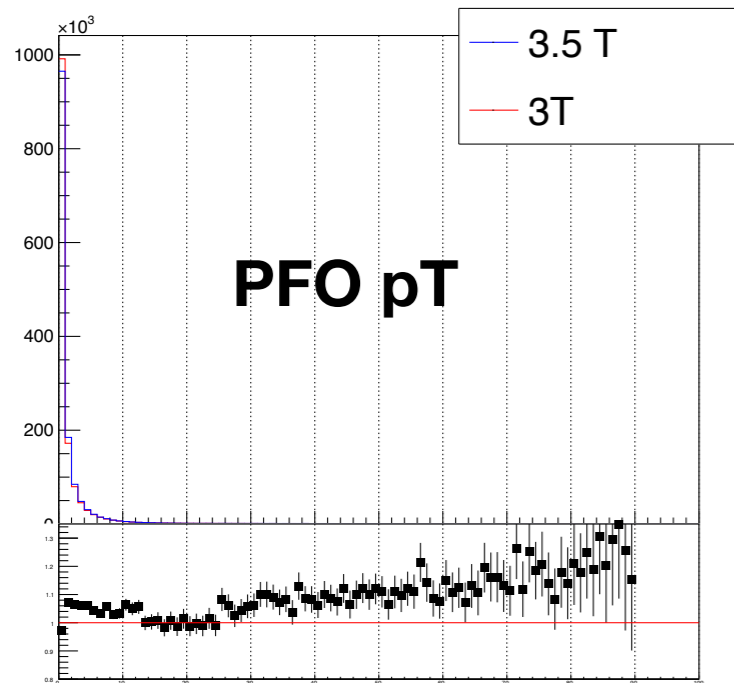
Compare on Jet Variable in Background



Pfo Distribution - I

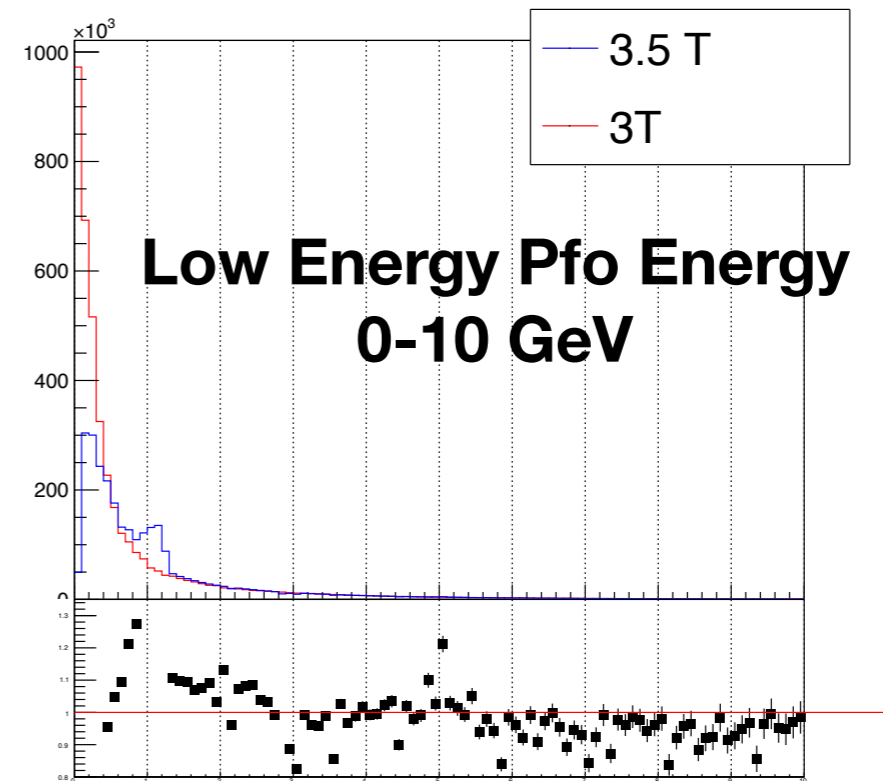
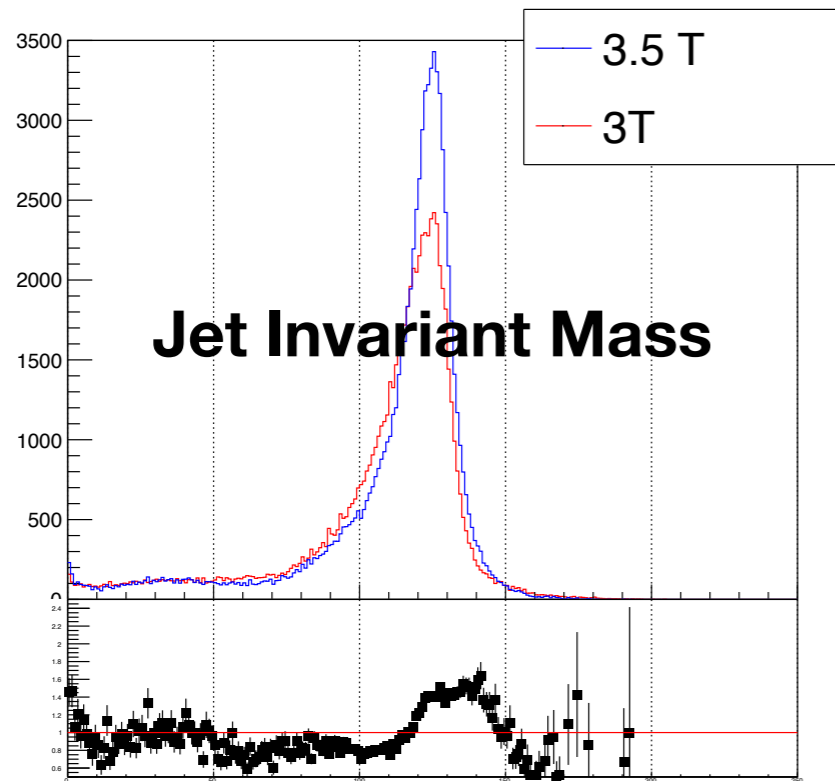


Pfo Distributions -II



Low Energy Neutral Seems Problematic

Discrepancy in Signal



There is also Discrepancy

Outline

- Full simulation of Signal and Dominant background (zzsl->mumu+qq)
- Background both from 3T and 3.5T are filtered
- Fit template not updated

Efficiency and Fit Configuration

| | H->bb | H->cc | H->gg |
|------|--------|--------|--------|
| 3.5T | 54.35% | 53.92% | 50.31% |
| 3T | 52.47% | 51.78% | 49.40% |

- **Signal Only Fit**
- **Signal Recoil :Crystal Ball + Double Sided Exponential**
- **Flavor template from MC**
- **H_{ww} and H_{zz} are fixed**

Cutflow of $H \rightarrow b\bar{b}$

| | 3T | 3.5T | Eff Ratio | InEff Ratio |
|------------------------|----------|----------|-----------|-------------|
| FSClasser | 86.4622% | 87.2201% | 0.99131 | 1.059304 |
| $\cos \theta_z$ | 83.2223% | 82.9499% | 1.003284 | 0.984024 |
| $\cos \theta_{\mu\mu}$ | 95.2939% | 95.4212% | 0.998666 | 1.027802 |
| $M_{\mu\mu}$ | 94.7533% | 96.0762% | 0.986231 | 1.337148 |
| M_recoil | 92.7102% | 92.7839% | 0.999206 | 1.010213 |
| 2J+Lep_Veto | 98.5379% | 99.2262% | 0.993063 | 1.889506 |
| JetnPFO | 99.4802% | 99.7175% | 0.997620 | 1.84 |
| $\cos \theta_{JJ}$ | 92.8495% | 92.8624% | 0.999861 | 1.001807 |
| M_{JJ} | 99.2394% | 99.6308% | 0.996071 | 2.060130 |
| y-value | 96.4361% | 96.4749% | 0.999598 | 1.01107 |

Cutflow of ZZ->mumu+bb

| | 3T | 3.5T | Eff Ratio |
|------------------------|---------|---------|-----------|
| Filter | 4.5% | | |
| FSClasser | Unknown | | |
| $\cos \theta_z$ | 68.021% | 68.619% | 0.9913 |
| $\cos \theta_{\mu\mu}$ | 89.068% | 89.052% | 1.0002 |
| $M_{\mu\mu}$ | 88.390% | 89.680% | 0.9968 |
| M_{recoil} | 44.845% | 45.302% | 0.9899 |
| 2J+Lep_Veto | 97.111% | 98.397% | 0.9869 |
| JetnPFO | 99.346% | 97.403% | 1.0199 |
| $\cos \theta_{JJ}$ | 91.916% | 92.420% | 0.9945 |
| M_{JJ} | 94.528% | 85.973% | 1.0995 |
| y-value | 93.246% | 94.013% | 0.9918 |

Fit Results Old Result

3 T

| | | | | | |
|----|--------------|--------------|-------------|-------------|--------------|
| 1 | C | 4.63771e-06 | 1.56602e-02 | 1.01085e-01 | -1.56399e+00 |
| 2 | a | -1.00557e+00 | 2.99852e-02 | 3.72188e-04 | -1.00727e-01 |
| 3 | a1 | -2.43770e-01 | 2.63290e-02 | 7.52463e-03 | -2.43770e-01 |
| 4 | mean | 1.25257e+02 | 6.39905e-03 | 1.72087e-03 | 1.75479e-01 |
| 5 | n | 9.41634e-01 | 2.88469e-02 | 2.42414e-03 | 2.98852e-01 |
| 6 | nHbb | 1.08464e+04 | 1.30466e+02 | 3.57319e-03 | 8.46955e-02 |
| 7 | nHcc | 4.96133e+02 | 5.49569e+01 | 7.18293e-03 | -1.12198e+00 |
| 8 | nHgg | 1.44653e+03 | 8.44655e+01 | 1.01782e-02 | -4.35290e-01 |
| 9 | nbkg | 9.76894e+00 | 9.79351e+00 | 3.14972e-02 | -1.37280e+00 |
| 10 | nzzsl_mu_bb | 1.29880e+03 | 8.37043e+01 | 7.34777e-03 | -6.80454e-01 |
| 11 | nzzsl_mu_cc | 1.40250e+03 | 5.94881e+01 | 6.03987e-03 | -6.42893e-01 |
| 12 | nzzsl_mu_uds | 4.09005e+03 | 8.59436e+01 | 2.99677e-03 | -6.32390e-01 |
| 13 | sigma | 3.13544e-01 | 6.19355e-03 | 3.97967e-03 | -4.84922e-01 |

True Value:

nHbb: 10806.7

nHcc: 497.2

nHgg: 1471.6

nzzsl_bb: 1339.6

nzzsl_cc: 1394.1

nzzsl_uds:4069.4

3.5 T

| EXT NO. | PARAMETER NAME | VALUE | ERROR | INTERNAL STEP SIZE | INTERNAL VALUE |
|---------|----------------|--------------|-------------|--------------------|----------------|
| 1 | C | 1.41328e-02 | 7.10576e-03 | 1.01215e-03 | -1.19261e+00 |
| 2 | a | -1.01980e+00 | 2.94849e-02 | 7.41963e-05 | -1.02158e-01 |
| 3 | a1 | -2.66733e-01 | 2.54298e-02 | 3.01040e-04 | -2.66733e-01 |
| 4 | mean | 1.25237e+02 | 5.49928e-03 | 5.93974e-05 | 1.52509e-01 |
| 5 | n | 9.26723e-01 | 2.62138e-02 | 9.01569e-05 | 2.88466e-01 |
| 6 | nHbb | 1.12289e+04 | 1.31894e+02 | 1.49502e-04 | 1.23154e-01 |
| 7 | nHcc | 5.13406e+02 | 5.57593e+01 | 2.94123e-04 | -1.11409e+00 |
| 8 | nHgg | 1.54518e+03 | 8.43853e+01 | 2.09080e-03 | -3.92181e-01 |
| 9 | nbkg | -3.45779e+00 | 1.68808e+01 | 7.00937e-04 | -9.69263e-01 |
| 10 | nzzsl_mu_bb | 1.37520e+03 | 8.65005e+01 | 3.07609e-04 | -6.52678e-01 |
| 11 | nzzsl_mu_cc | 1.46155e+03 | 5.98813e+01 | 2.46129e-04 | -6.21972e-01 |
| 12 | nzzsl_mu_uds | 4.30471e+03 | 8.62719e+01 | 1.22858e-04 | -6.06028e-01 |
| 13 | sigma | 2.69436e-01 | 5.42597e-03 | 1.48470e-04 | -6.14327e-01 |

ERR DEF= 0.5

True Value:

nHbb: 11188.2

nHcc: 518.2

nHgg: 1502.4

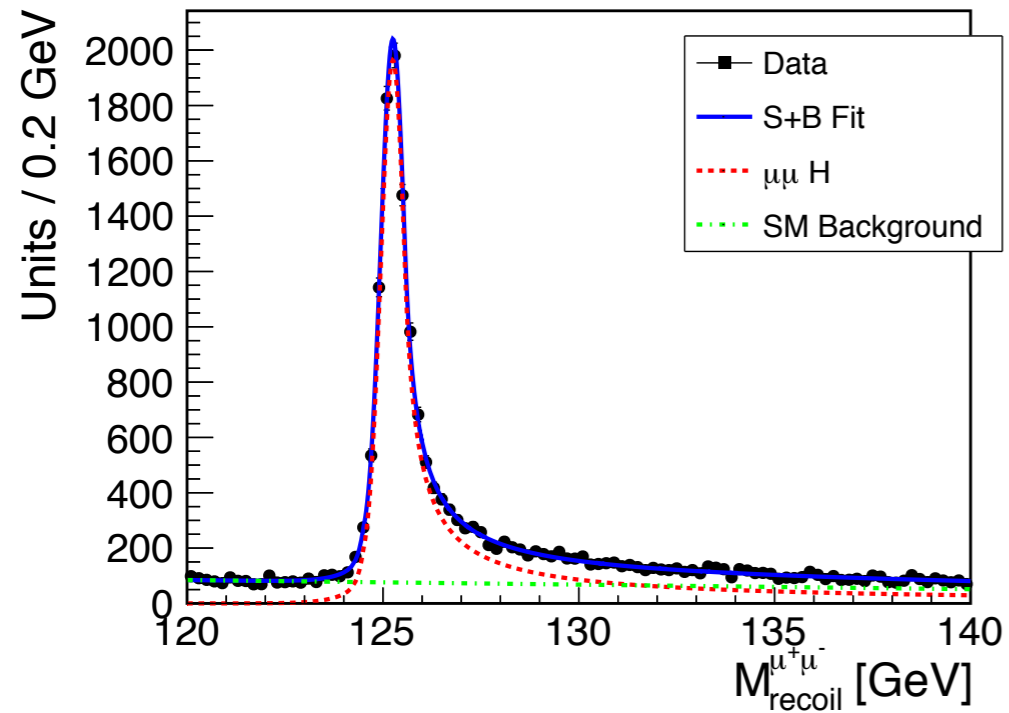
nzzsl_bb: 1423.2

nzzsl_cc:1447.3238

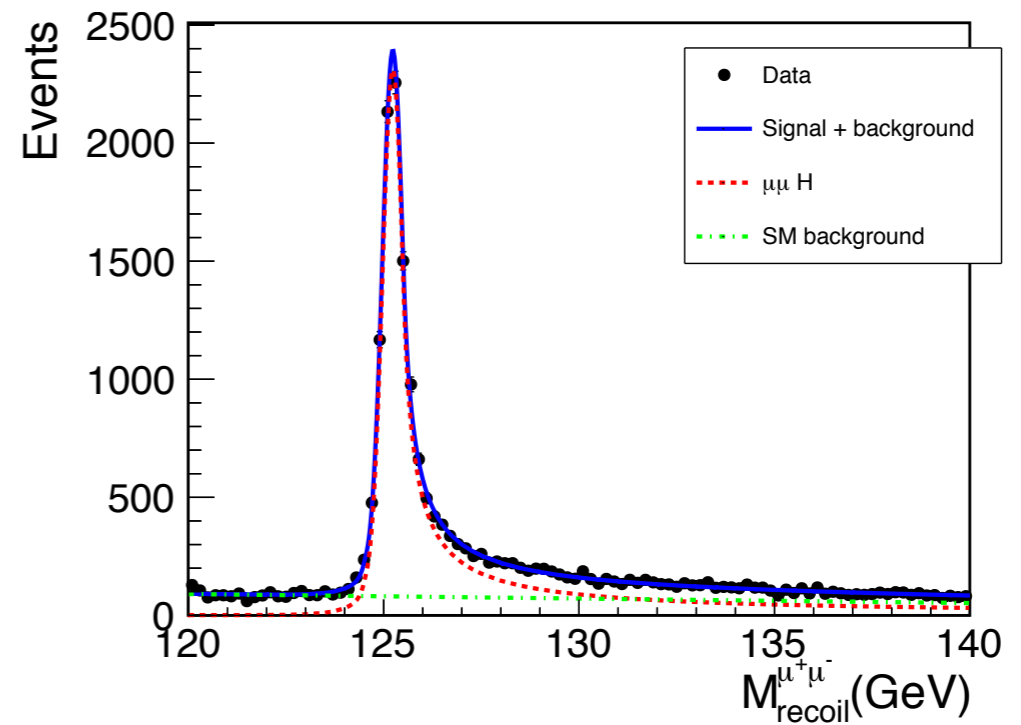
nzzsl_uds: 4330.6

Mrecoil from Fit

3 T

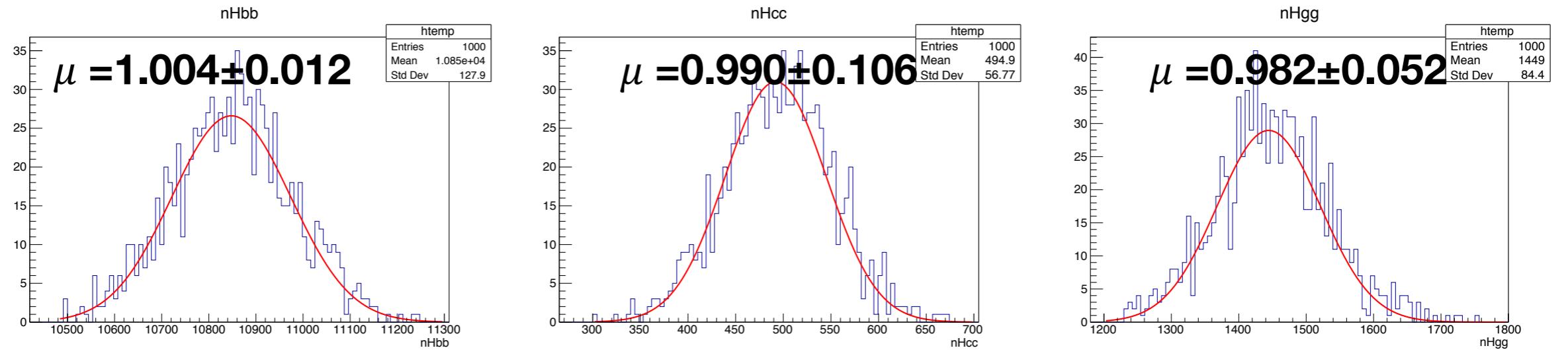


3.5 T

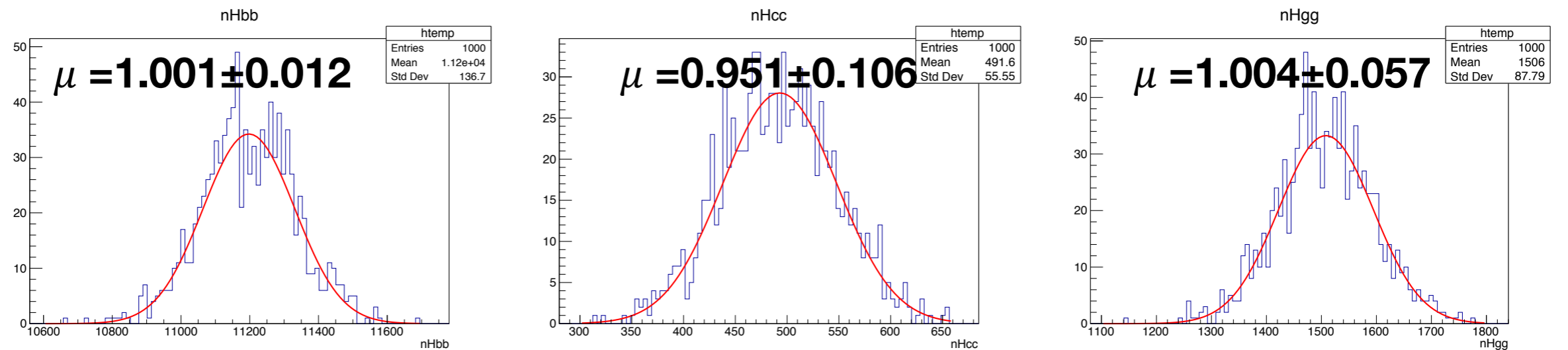


Results of ToyMC

3T



3.5T



No Significant change in terms of uncertainty

Backup

Conclusion

- A shift found in SM $m_{\mu\mu+qq}$ background, leading to difference in jet pair invariance cut efficiency
- No significant change found in terms of the uncertainty from toyMC

Cutflow $zz_{sl} \rightarrow mumuqq$ (old result)

| | 3T down | 3.5T down | 3T up | 3.5T up |
|------------------------|---------|-----------|-------|---------|
| FSClasser+filter | 21699 | 24189 | 14259 | 15367 |
| $\cos \theta_z$ | 14984 | 16853 | 9821 | 10627 |
| $\cos \theta_{\mu\mu}$ | 13367 | 15002 | 8638 | 9327 |
| $M_{\mu\mu}$ | 11893 | 13524 | 7725 | 8429 |
| M_{recoil} | 5434 | 6209 | 3617 | 3942 |
| 2J+Lep_Veto | 5147 | 6111 | 3450 | 3906 |
| JetnPFO | 4992 | 5632 | 3326 | 3589 |
| $\cos \theta_{JJ}$ | 4580 | 5188 | 3030 | 3291 |
| M_{JJ} | 4434 | 4672 | 2903 | 3054 |
| y-value | 4145 | 4375 | 2726 | 2857 |

Fit Results Old Result

3 T

| EXT NO. | PARAMETER NAME | VALUE | ERROR | INTERNAL STEP SIZE | INTERNAL VALUE |
|---------|----------------|--------------|-------------|--------------------|----------------|
| 1 | C | 2.98443e-02 | 1.16010e-02 | 3.22969e-02 | -1.01746e+00 |
| 2 | a | -1.03607e+00 | 3.15654e-02 | 4.79707e-04 | -1.03789e-01 |
| 3 | a1 | -3.44392e-01 | 1.92103e-02 | 6.12484e-03 | -3.44392e-01 |
| 4 | mean | 1.25256e+02 | 6.52233e-03 | 1.96390e-03 | 1.74202e-01 |
| 5 | n | 9.17291e-01 | 3.01802e-02 | 2.76175e-03 | 2.81914e-01 |
| 6 | nHbb | 1.09549e+04 | 1.38980e+02 | 4.07062e-03 | 9.55916e-02 |
| 7 | nHcc | 5.41724e+02 | 6.00616e+01 | 8.19061e-03 | -1.10141e+00 |
| 8 | nHgg | 1.41318e+03 | 9.02291e+01 | 1.22954e-02 | -4.50956e-01 |
| 9 | nbkg | 3.39381e+00 | 9.68549e+00 | 6.40192e-02 | -1.46313e+00 |
| 10 | nzzsl_mu_bb | 2.42790e+03 | 1.04827e+02 | 8.22363e-03 | -3.11516e-01 |
| 11 | nzzsl_mu_cc | 2.08545e+03 | 7.09836e+01 | 6.90997e-03 | -4.16277e-01 |
| 12 | nzzsl_mu_uds | 7.08060e+03 | 1.06463e+02 | 3.51638e-03 | -2.96322e-01 |
| 13 | sigma | 3.22645e-01 | 6.59870e-03 | 4.57437e-03 | -4.59375e-01 |

FRR DEF= 0.5

True Value:
nHbb: 10806
nHcc: 497
nHgg: 1471.6

3.5 T

| EXT NO. | PARAMETER NAME | VALUE | ERROR | INTERNAL STEP SIZE | INTERNAL VALUE |
|--|----------------|--------------|-------------|--------------------|----------------|
| 1 | C | 1.41257e-02 | 7.10497e-03 | 1.01210e-03 | -1.19271e+00 |
| 2 | a | -1.01976e+00 | 2.94921e-02 | 7.42029e-05 | -1.02154e-01 |
| 3 | a1 | -2.66861e-01 | 2.54429e-02 | 3.01143e-04 | -2.66861e-01 |
| 4 | mean | 1.25237e+02 | 5.50034e-03 | 5.94020e-05 | 1.52510e-01 |
| 5 | n | 9.26916e-01 | 2.62238e-02 | 9.02018e-05 | 2.88600e-01 |
| 6 | nHhh | 1.12777e+04 | 1.31890e+02 | 1.49491e-04 | 1.73038e-01 |
| 7 | nHcc | 5.13029e+02 | 5.57565e+01 | 2.94354e-04 | -1.11426e+00 |
| 8 | nHgg | 1.54453e+03 | 8.43753e+01 | 4.18157e-04 | -3.92464e-01 |
| 9 | nbkg | 5.00001e-01 | 7.91414e+00 | 4.45507e-01 | -1.57075e+00 |
| WARNING - ABOVE PARAMETER IS AT LIMIT. | | | | | |
| 10 | nzzsl_mu_bb | 1.37509e+03 | 8.65210e+01 | 3.07649e-04 | -6.52715e-01 |
| 11 | nzzsl_mu_cc | 1.46088e+03 | 5.98302e+01 | 2.46184e-04 | -6.22211e-01 |
| 12 | nzzsl_mu_uds | 4.30346e+03 | 8.63575e+01 | 1.22372e-04 | -6.06180e-01 |
| 13 | sigma | 2.69430e-01 | 5.42687e-03 | 1.48477e-04 | -6.14320e-01 |

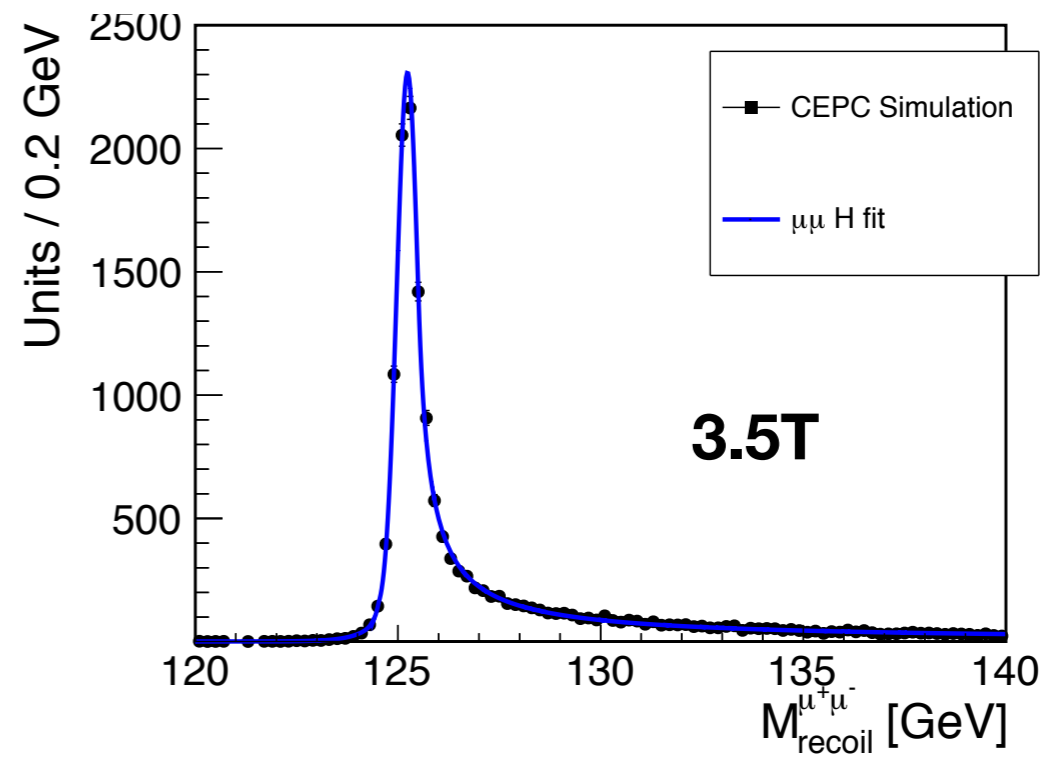
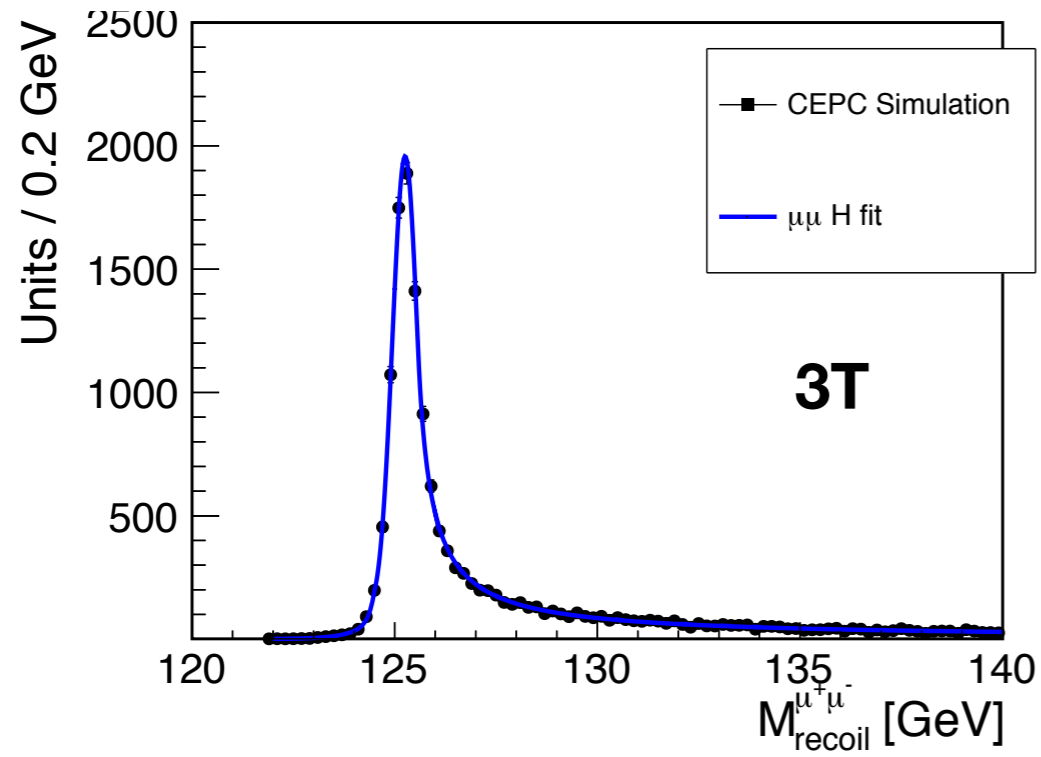
FRR DEF= 0.5

True Value:
nHbb: 11188.2
nHcc: 518.2
nHgg: 1502.4

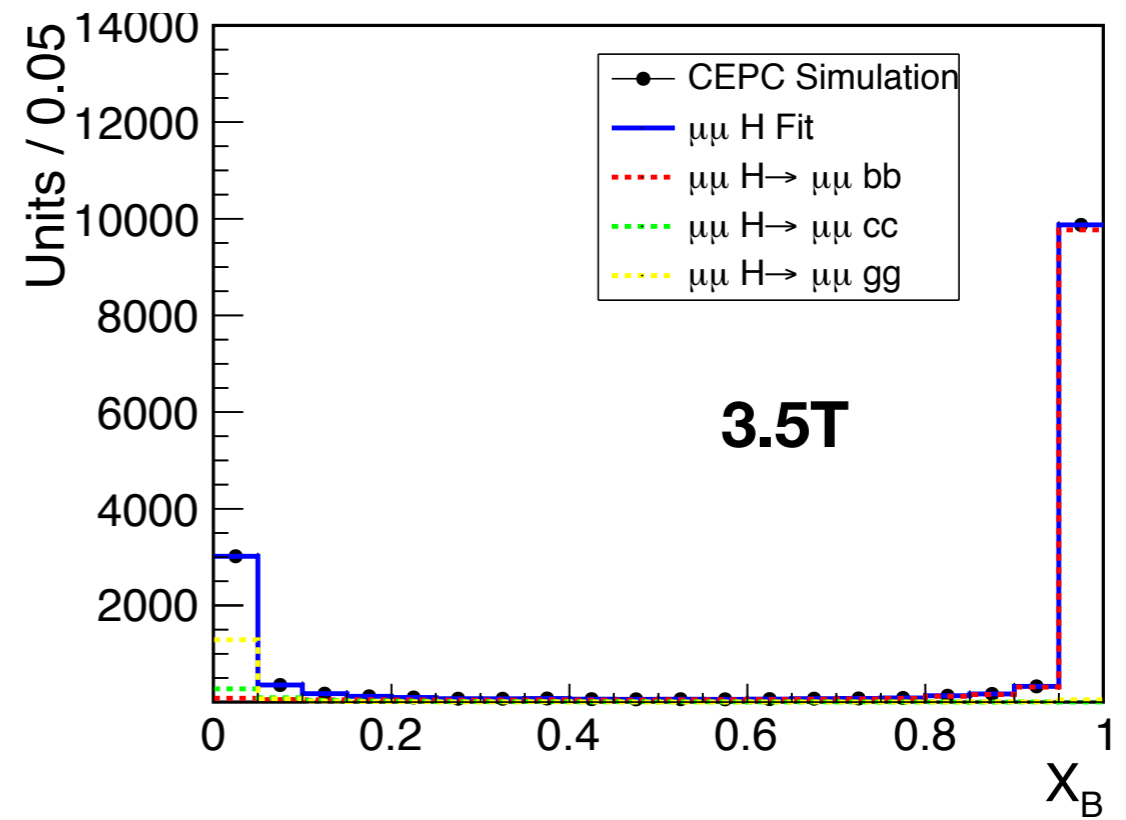
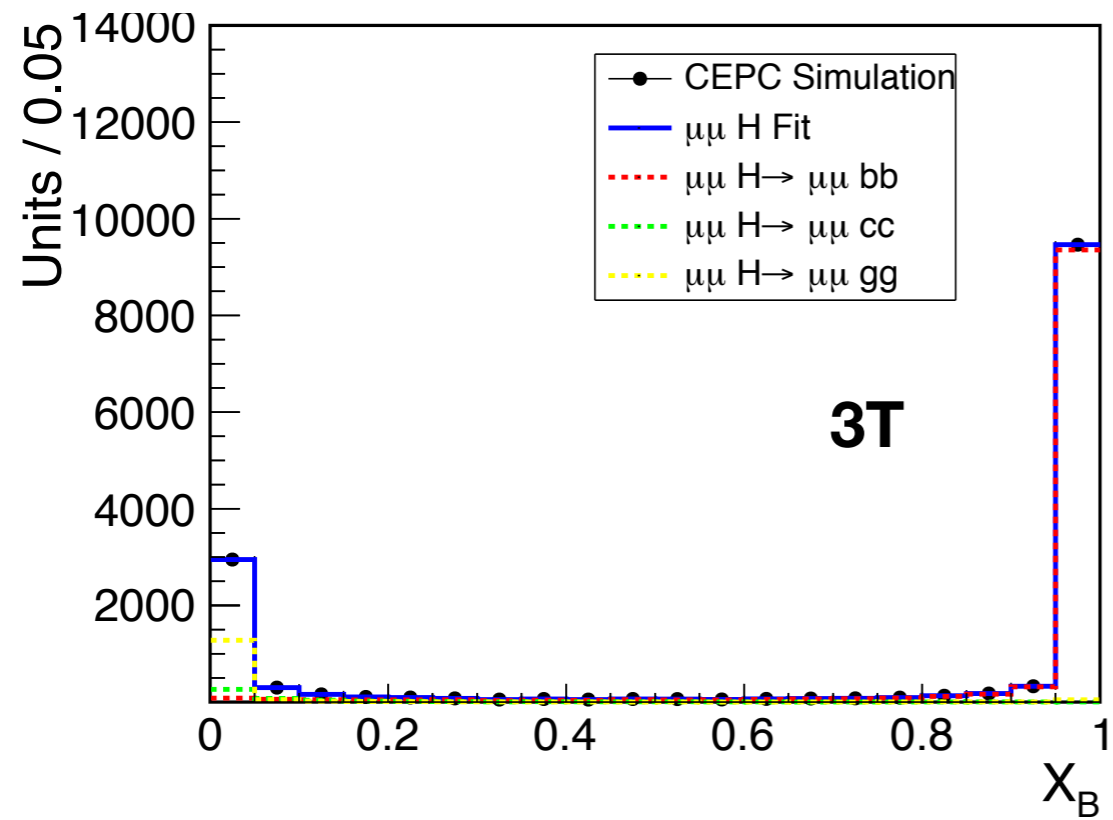
Fit Result

| | 3T | | 3.5 T | |
|------------------------------|-------------------------|--------------------------|-------------------------|--------------------------|
| | Value | ERROR | VALUE | ERROR |
| nHbb | 1.08074×10^4 | 106.798 | 1.111884×10^4 | 108.469 |
| nHcc | 496.335 | 40.874 | 518.285 | 40.8309 |
| nHgg | 1.46764×10^3 | 57.649 | 1.50056×10^3 | 58.8540 |
| nHbkg | 13.7384 | 8.19635 | 15.7974 | 8.20483 |
| sigma | 0.316155 | 6.08143×10^{-3} | 0.269189 | 5.05385×10^{-3} |
| mean | 125.259 | 6.28207×10^{-3} | 125.237 | 5.39250×10^{-3} |
| a | -1.00508 | 0.027144 | -1.00956 | 2.64415×10^{-2} |
| n | 0.948601 | 0.0219960 | 0.939792 | 0.0204244 |
| peak | 124.496 | - | 124.524 | - |
| tau | 0.503652 | - | 0.463546 | - |
| tail_fraction | 0.96875879 | - | 0.9636108 | - |
| $\mu_{H \rightarrow bb} - 1$ | 9.91×10^{-5} | 9.88×10^{-3} | -6.164×10^{-3} | 9.695×10^{-3} |
| $\mu_{H \rightarrow cc} - 1$ | -1.74×10^{-3} | 8.22×10^{-2} | 1.76×10^{-4} | 0.078795 |
| $\mu_{H \rightarrow gg} - 1$ | -2.679×10^{-3} | 3.917×10^{-2} | -1.199×10^{-3} | 0.039174 |

M_recoil



B Likeness



C Likeness

