

Parameterisation Check

Zgamma EFT

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Comparison between different method

- How to calculate **a**, **b** and **c** factor ?
 - Use event yields in each bin for different histograms
- For example :
 - Inputs : $\text{hist}(0)$, $\text{hist}(C_{\tilde{B}W} = 1.5)$, $\text{hist}(C_{\tilde{B}W} = -1.5)$, cp : coupling value = 1.5
 - In bin i :
 - $a = (\text{pos} + \text{neg} - 2 * \text{zero}) / (2 * cp * cp)$
 - $b = (\text{pos} - \text{neg}) / (2 * cp)$
 - $c = \text{zero}$
 - pos : bin content for $\text{hist}(C_{\tilde{B}W}=1.5)$, neg : bin content for $\text{hist}(C_{\tilde{B}W}=-1.5)$, zero : bin content for $\text{hist}(0)$, Standard Model distribution , Sherpa 2.2.11

Comparison between different method

- Table for calculated **a**, **b**, **c** factor from $C_{\tilde{B}W}$ operator ($C_{\tilde{B}W} = \pm 1.2$)
 - Calculated from p_T^γ distribution

Bin index	a	b	c
1	10.0692	-0.00115984	120.903
2	7.17194	0.099771	71.1677
3	3.41346	0.00555356	54.4834
4	4.93697	-0.0806296	35.3501
5	5.21998	-0.272647	24.5852
6	3.70313	-0.193122	12.4363
7	6.68696	0.0100746	5.82101

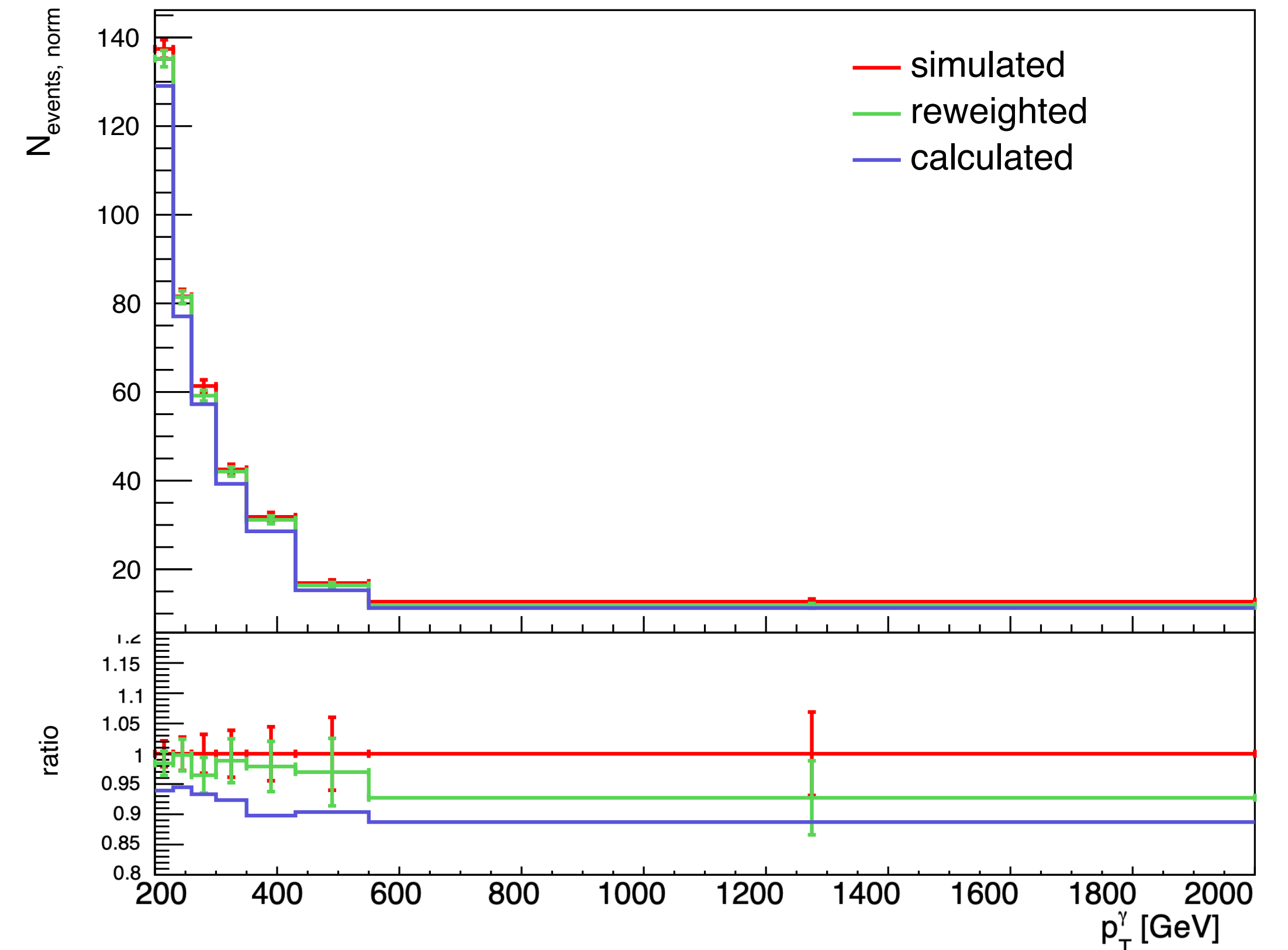
Comparison between different method

- Event yields comparison results for different method

From $C_{\tilde{B}W} = \pm 1.2$

To $C_{\tilde{B}W} = 0.9$

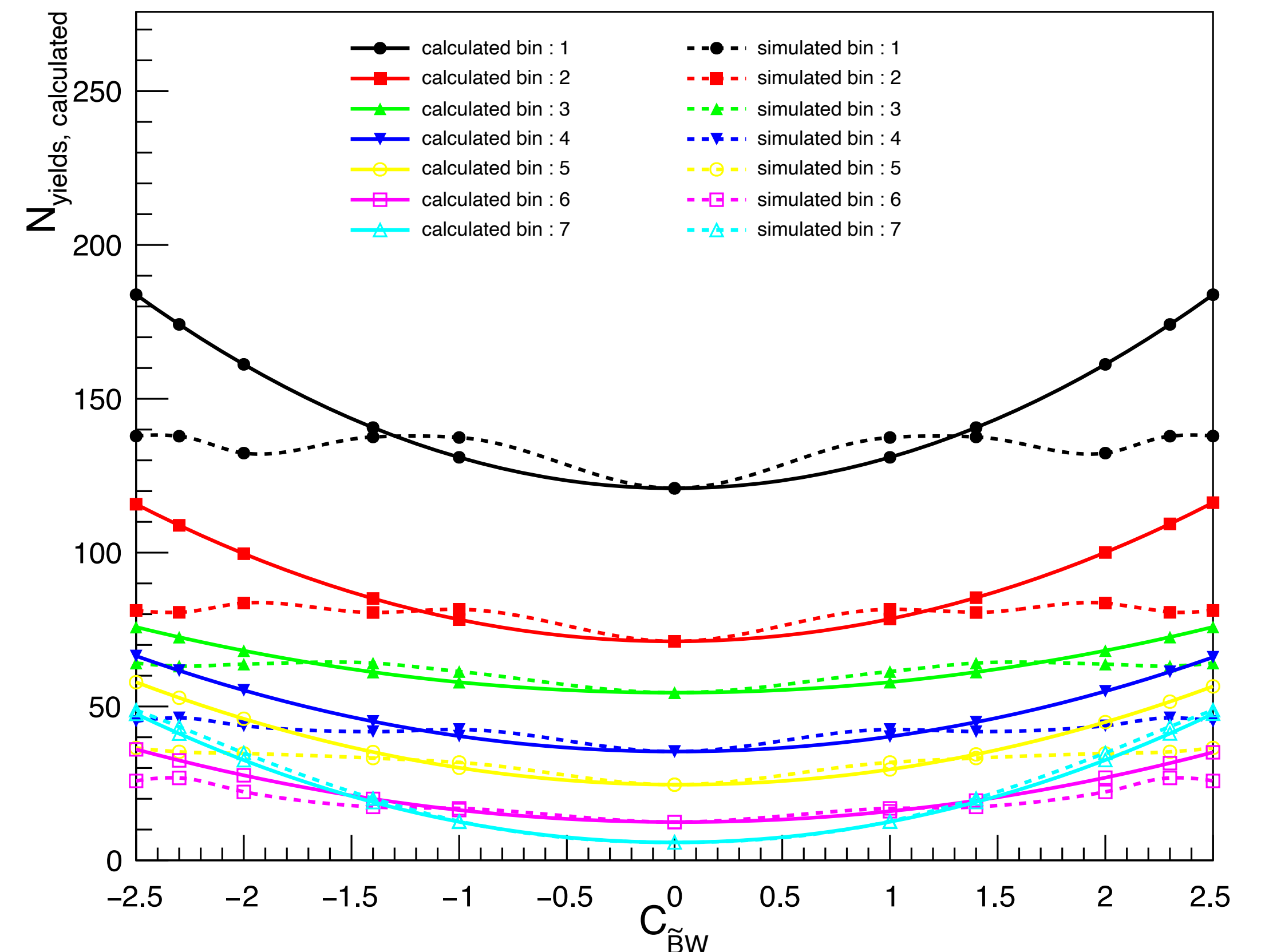
Bin index	Simulated	Re-weighted	Calculated
1	137.413	134.36	129.058
2	81.58	80.8897	77.0668
3	61.3552	58.7993	57.2533
4	42.5301	41.7725	39.2765
5	31.8181	30.9476	28.568
6	16.8882	16.2719	15.262
7	12.6772	11.6789	11.2465



Scan results

- Plots of a, b, c factors — quadratic function
- Explanation for the plots
 - Solid line : calculated bin content for different coupling values from parameterised factors a, b and c ($a \cdot c_p \cdot c_p + b \cdot c_p + c$)
 - Dashed line : simulated bin content for different coupling values
- If quadratic function is the right formula for parameterisation, then the solid line and the dashed line should match very well
 - Doesn't match except for the last bin
 - Shouldn't use $a \cdot x^2 + b \cdot x + c$ for the first 6 bins during the parameterisation

From $C_{\tilde{B}W} = \pm 1.2$ to $C_{\tilde{B}W} = 0.9$



Scan results

- Why $a \cdot x^2 + b \cdot x + c$ is not suitable for the first 6 bins ?
 - In the first 6 bins, the vast majority of events are Standard Model events
 - Will not be influenced by the varying of coupling values
 - For the last bin, sensitive to nTGC effects (nTGC effects will mostly reflect on the high p_T region)
 - Sensitive to the varying of coupling values
- For the first 6 bins, need to discuss and to decide the parameterisation functions
 - Const ? Or other formula ?

Backup slides

Comparison between different method

- Table for calculated **a**, **b**, **c** factor from C_{BB} operator ($C_{BB} = \pm 1.2$)
 - Calculated from p_T^γ distribution

Bin index	a	b	c
1	10.4088	0.302086	120.903
2	6.05644	0.175271	71.1677
3	6.30456	0.181882	54.4834
4	3.93371	0.0448195	35.3501
5	5.32075	-0.0900353	24.5852
6	4.94002	-0.008367	12.4363
7	10.9608	0.933786	5.82101

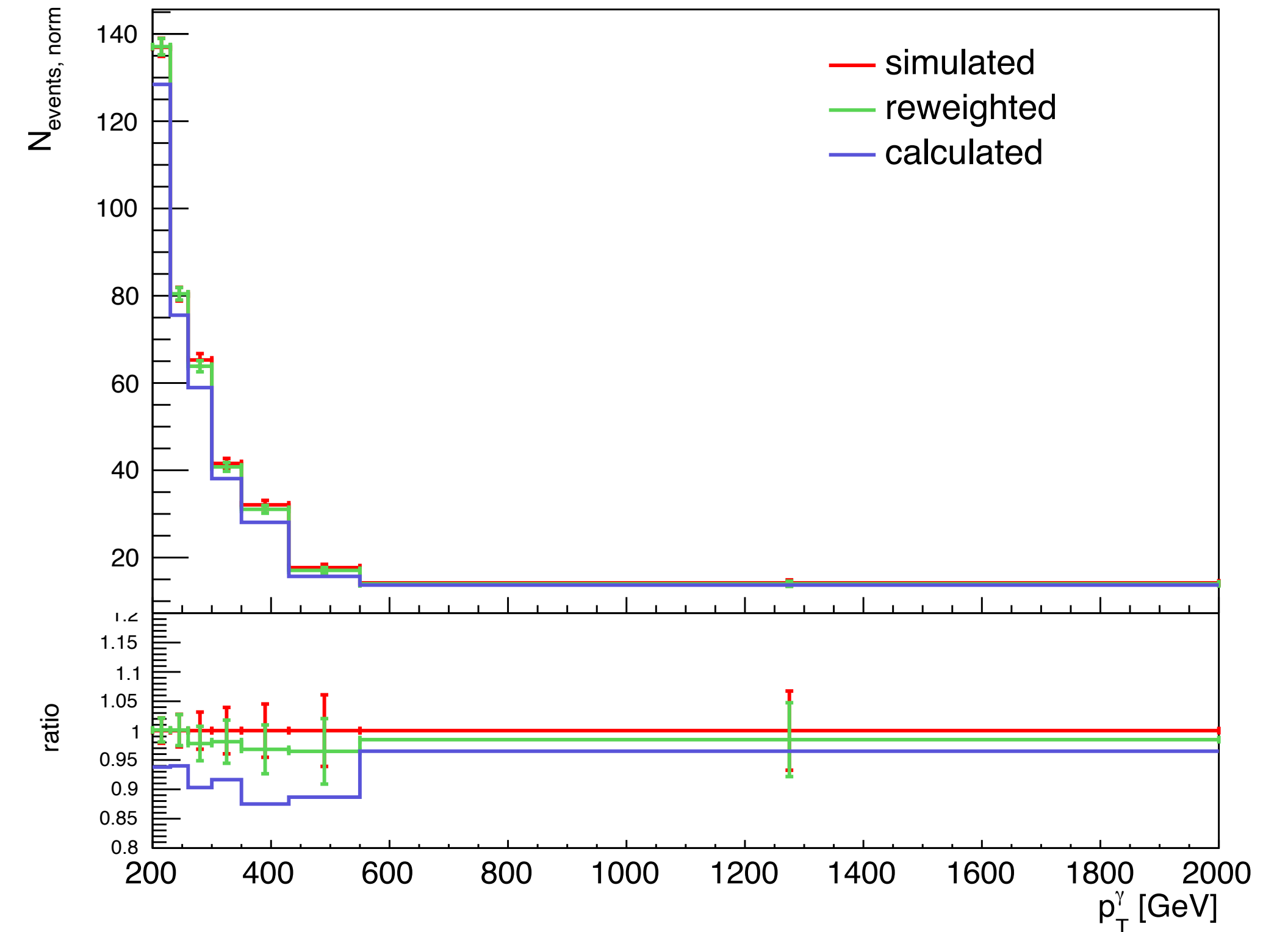
Comparison between different method

- Event yields comparison results for different method

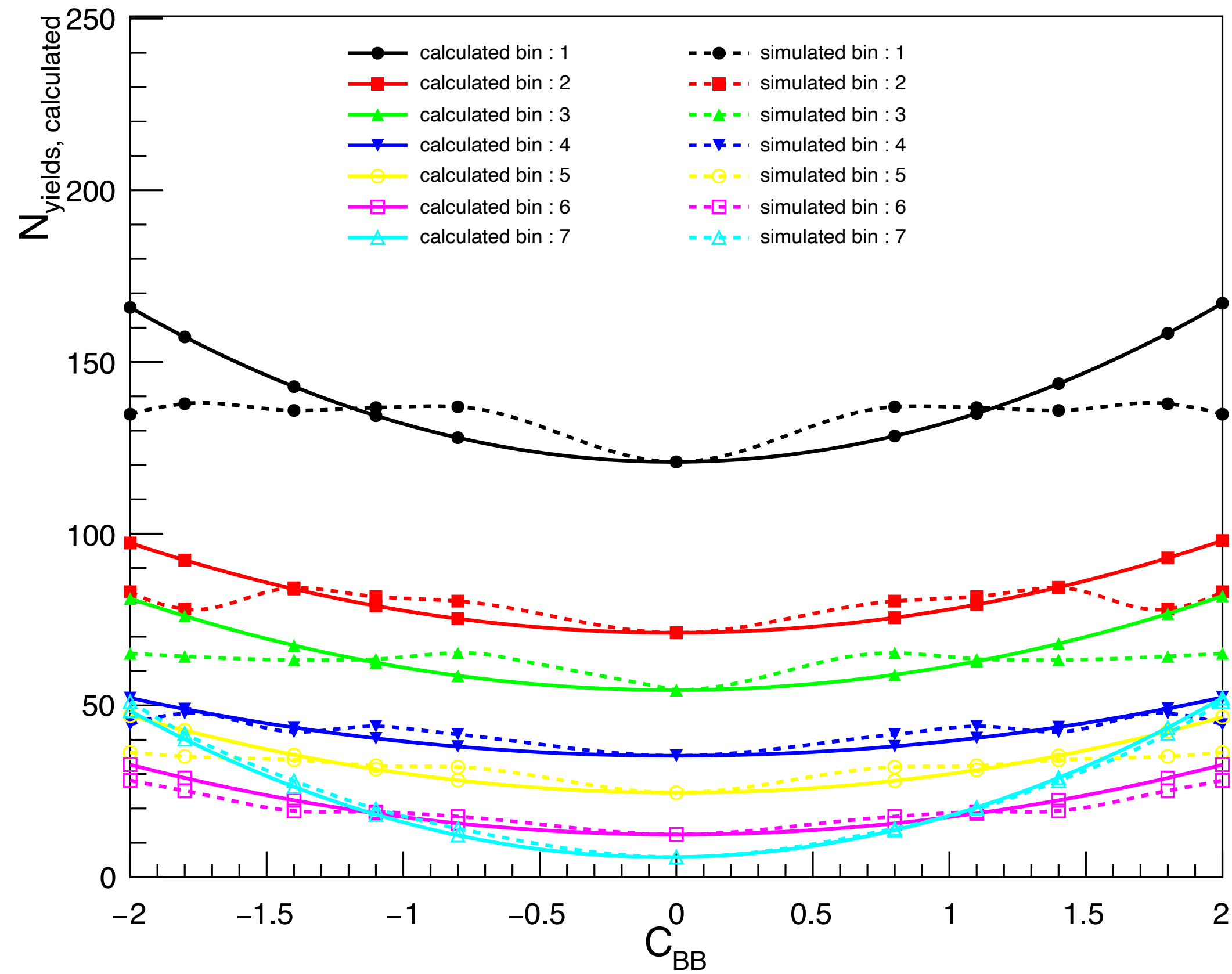
From $C_{BB} = \pm 1.2$

To $C_{BB} = 0.8$

Bin index	Simulated	Re-weighted	Calculated
1	136.946	135.685	129.606
2	80.3711	79.6458	76.2312
3	65.2823	63.1988	59.7527
4	41.561	40.3668	38.5767
5	32.0775	30.7303	28.814
6	17.6851	16.8879	16.4302
7	15.1919	13.8215	15.5397



Scan Results



- From $C_{BB} = \pm 1.2$ to $C_{BB} = 0.8$
- Same conclusion with $C_{\tilde{B}W}$ operator

Comparison between different method

- Table for calculated **a**, **b**, **c** factor from C_{BW} operator($C_{BW} = \pm 3.5$)
 - Calculated from p_T^γ distribution

Bin index	a	b	c
1	1.30071	-0.161201	120.903
2	0.712551	-0.0944771	71.1677
3	0.764233	-0.0425811	54.4834
4	0.589978	-0.0290147	35.3501
5	0.476189	-0.0616902	24.5852
6	0.629839	0.29978	12.4363
7	1.77092	0.100711	5.82101

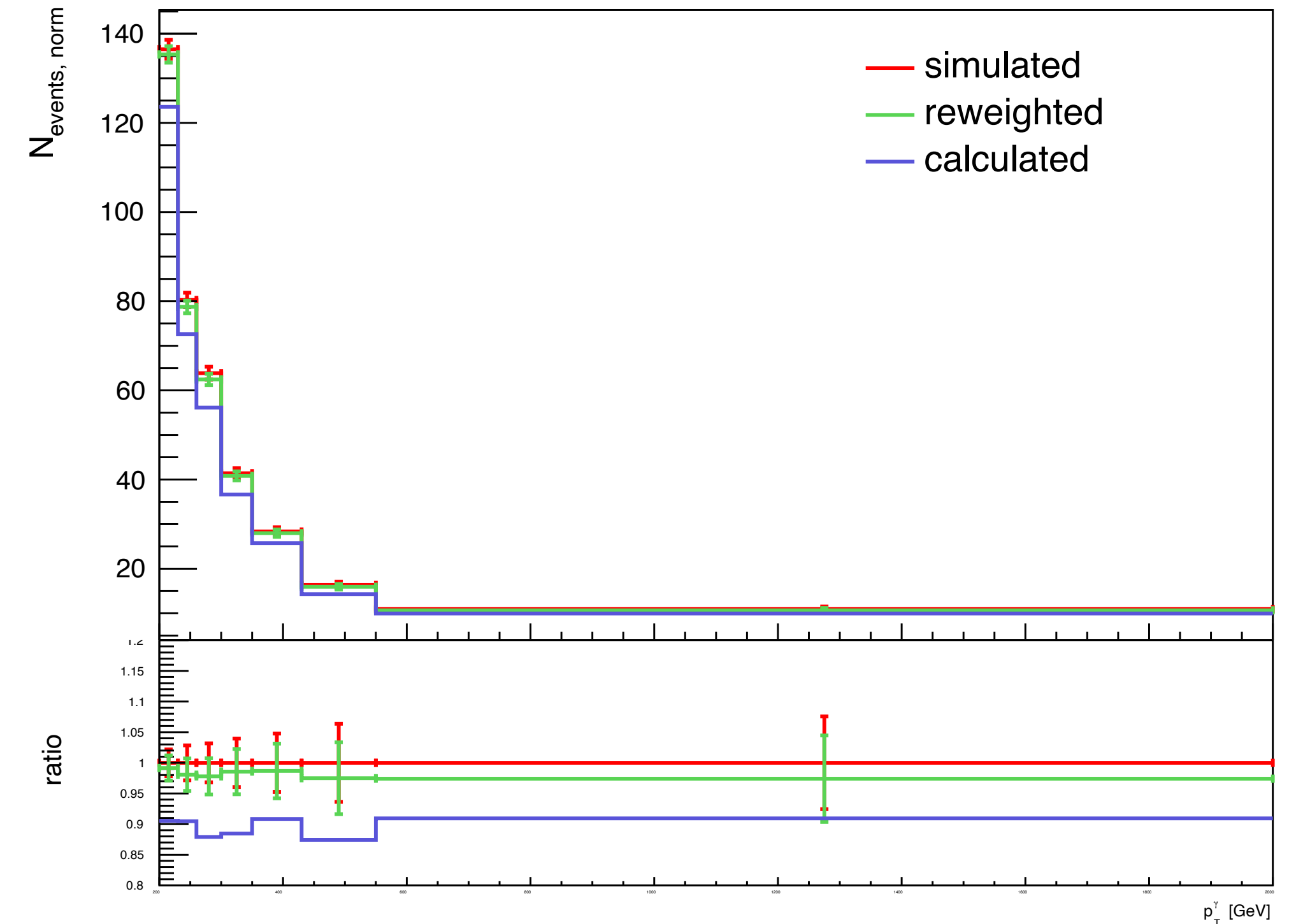
Comparison between different method

- Event yields comparison results for different method

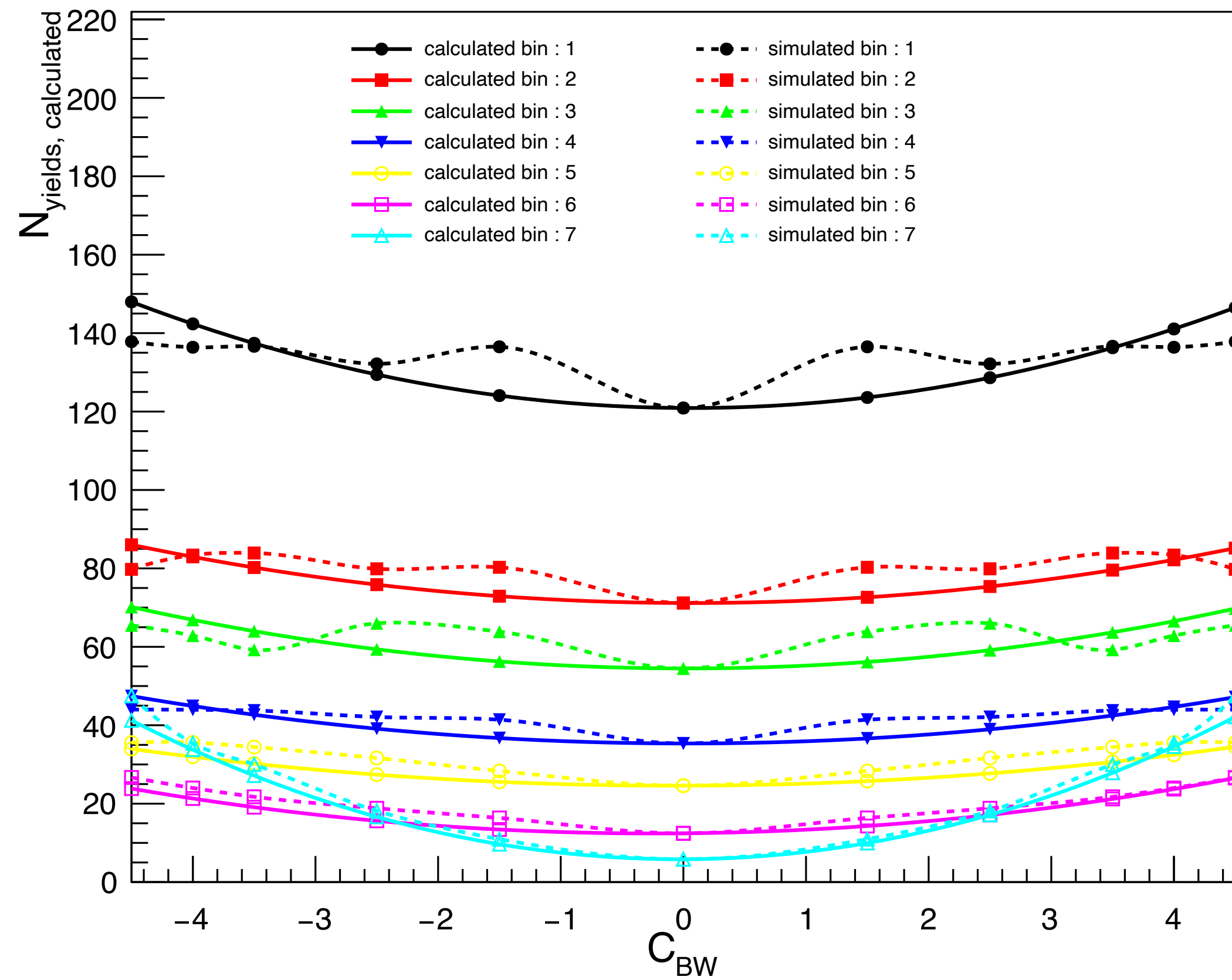
From $C_{BW} = \pm 3.5$

To $C_{BW} = 1.5$

Bin index	Simulated	Re-weighted	Calculated
1	136.509	135.354	123.588
2	80.2801	78.7245	72.6292
3	63.8643	62.4523	56.1391
4	41.414	40.8205	36.634
5	28.3459	27.9692	25.7492
6	16.3593	15.9485	14.3031
7	10.9493	10.6656	9.95665



Scan Results



- From $C_{BW} = \pm 3.5$ to $C_{BW} = 1.5$
- Same conclusion with $C_{\tilde{B}W}$, C_{BB} operator

Comparison between different method

- Table for calculated **a, b, c** factor from C_{WW} operator ($C_{WW} = \pm 7.0$)
 - Calculated from p_T^γ distribution

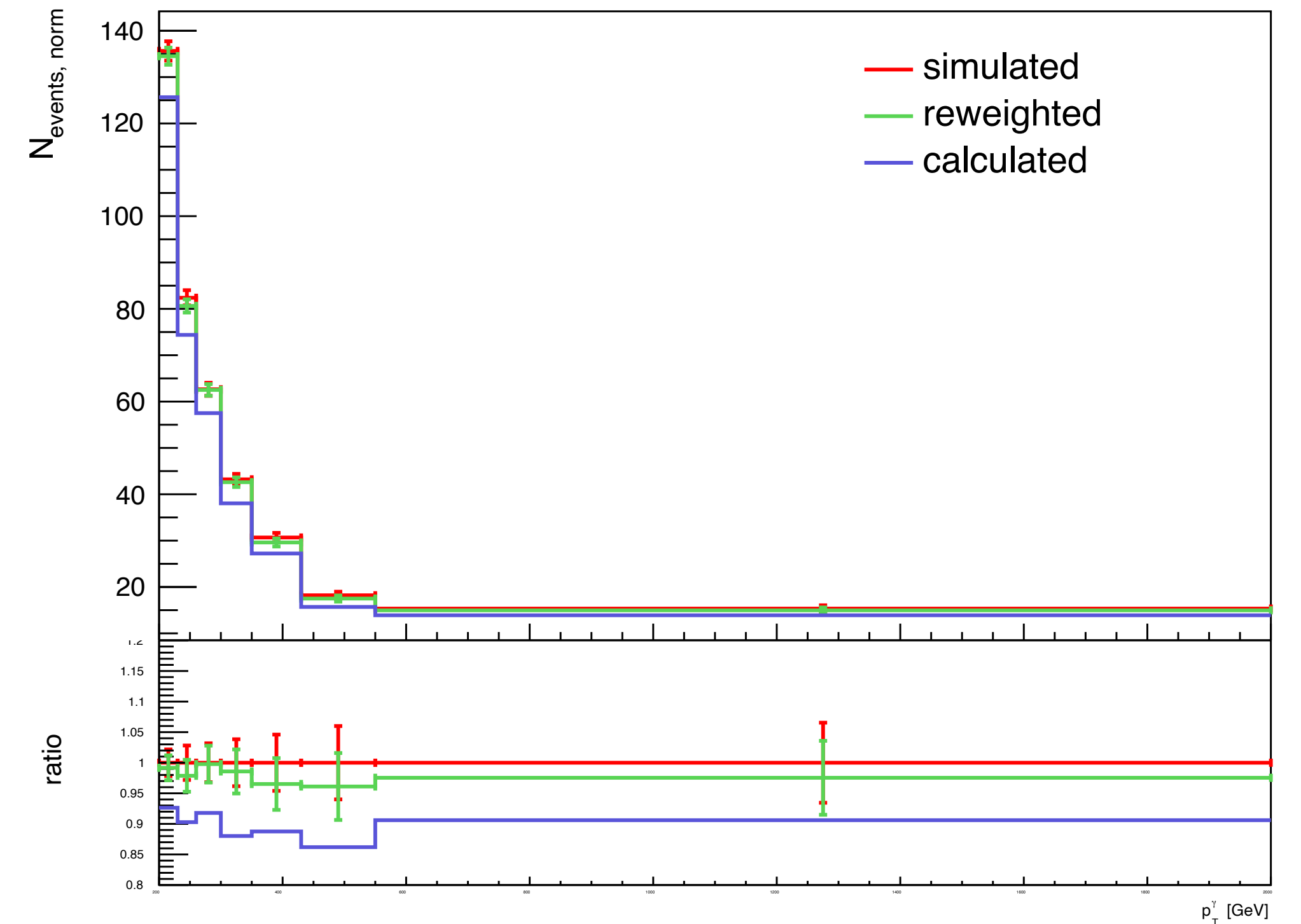
Bin index	a	b	c
1	0.300356	-0.0136961	120.903
2	0.21652	-0.0618259	71.1677
3	0.184857	0.0168389	54.4834
4	0.189916	-0.0853857	35.3501
5	0.141515	0.0945141	24.5852
6	0.177626	0.104842	12.4363
7	0.541799	-0.147359	5.82101

Comparison between different method

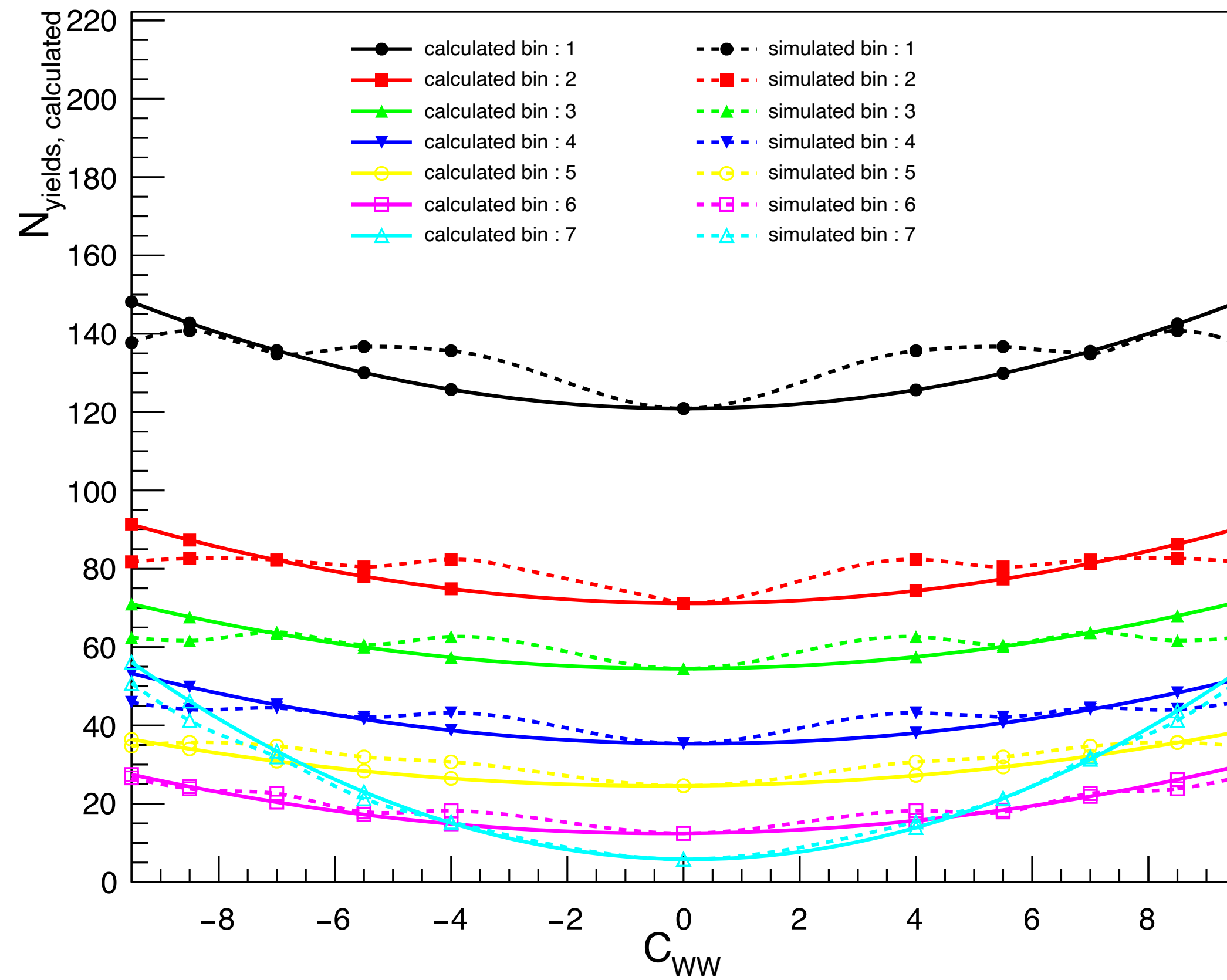
- Event yields comparison results for different method From $C_{WW} = \pm 7.0$

To $C_{WW} = 4.0$

Bin index	Simulated	Re-weighted	Calculated
1	135.64	134.508	125.654
2	82.3907	80.6344	74.3847
3	62.651	62.5093	57.5085
4	43.2254	42.6093	38.0472
5	30.6746	29.6067	27.2275
6	18.2114	17.5037	15.6977
7	15.3418	14.9641	13.9004



Scan Results



- From $C_{WW} = \pm 7.0$ to $C_{WW} = 4.0$
- Same conclusion with $C_{\tilde{B}W}$, C_{BB} , C_{BW} operator

Comparison between different method

- Table for calculated **a**, **b**, **c** factor from **cg** operator($cg = \pm 0.07$)
 - Calculated from p_T^γ distribution

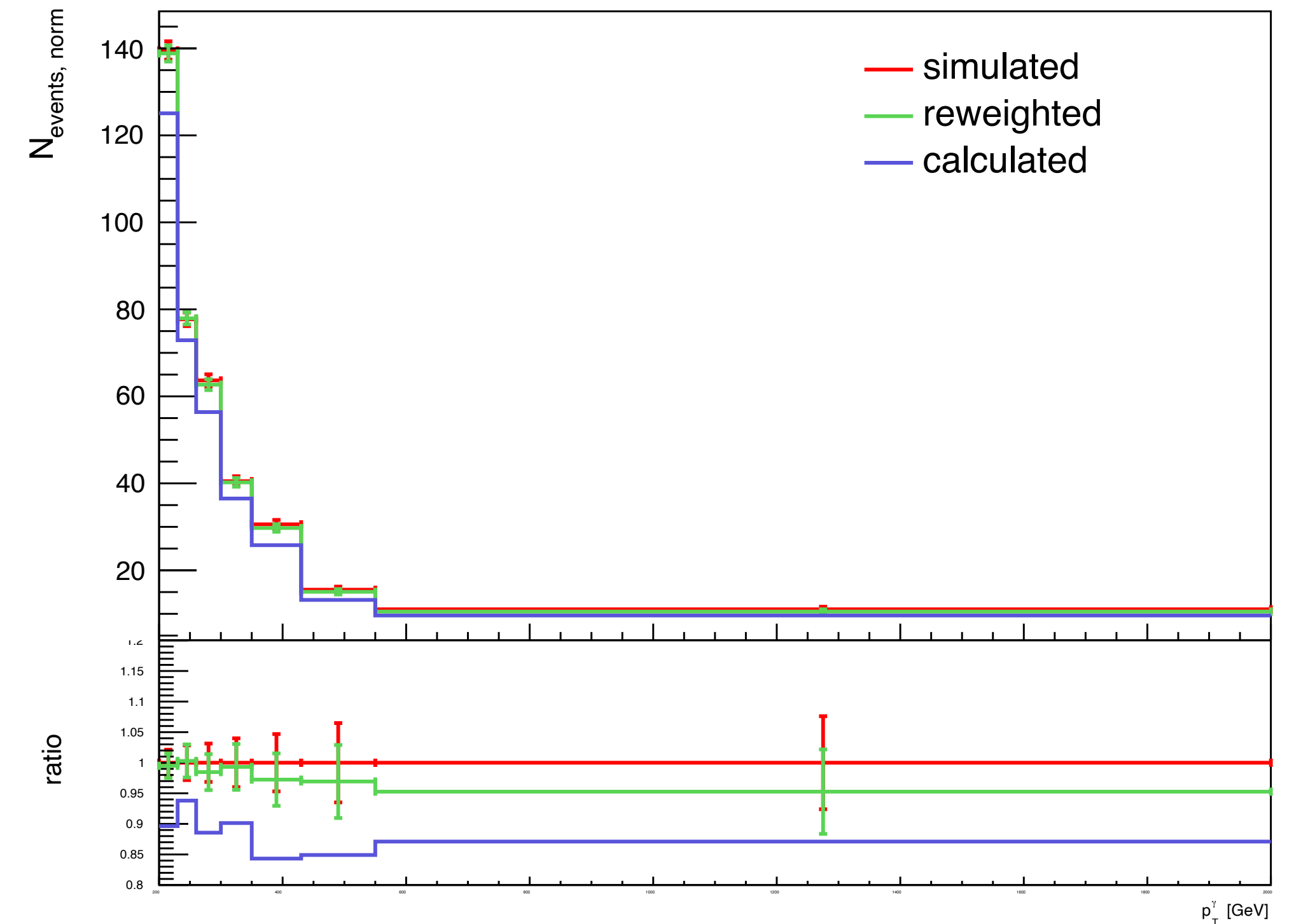
Bin index	a	b	c
1	4615.85	0.442618	120.903
2	1921.34	0.0254512	71.1677
3	2116.54	-0.183999	54.4834
4	1284.26	-0.0253369	35.3501
5	1293.22	1.18832	24.5852
6	848.758	-0.102317	12.4363
7	3960.55	7.77537	5.82101

Comparison between different method

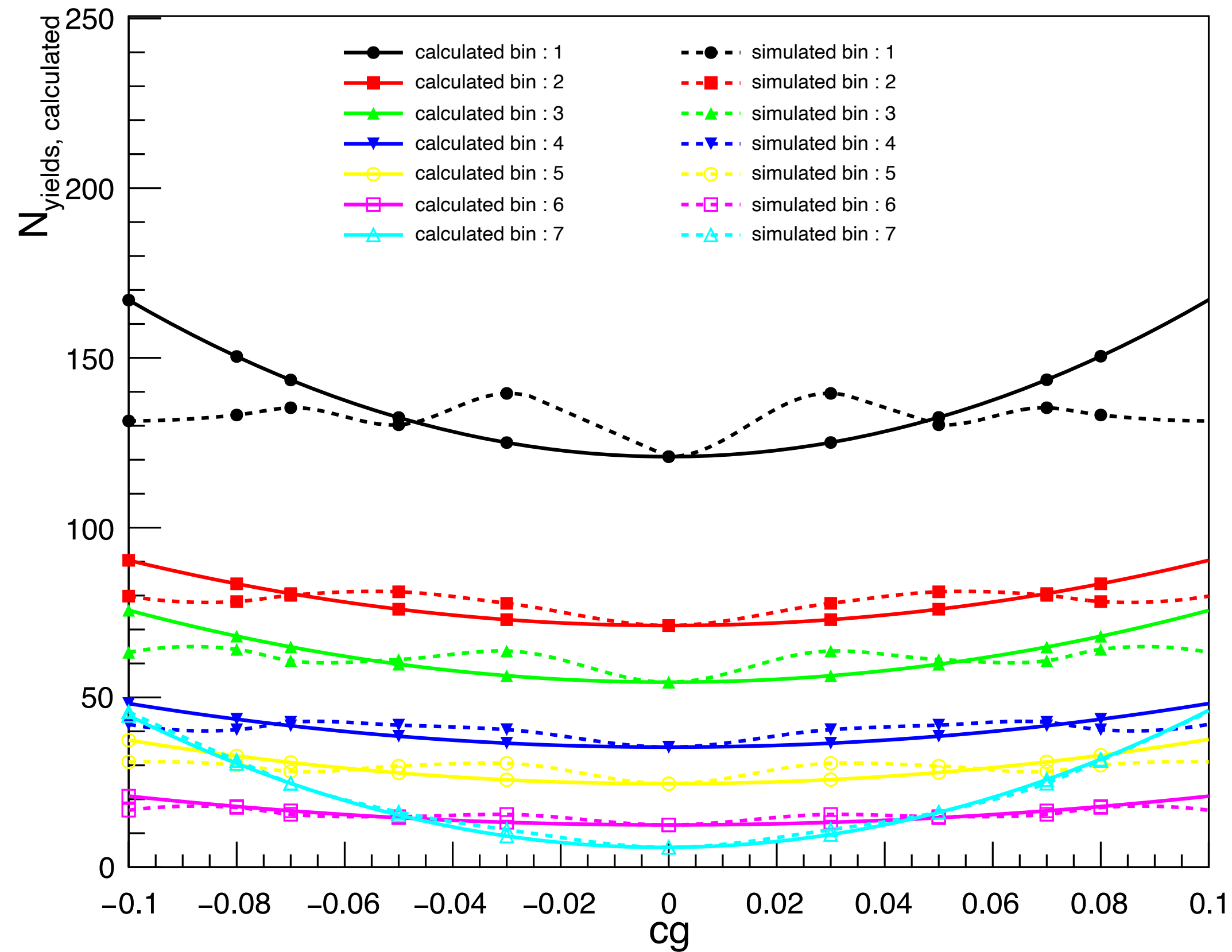
- Event yields comparison results for different method From $cg = \pm 0.07$

To $cg = 0.03$

Bin index	Simulated	Re-weighted	Calculated
1	139.53	138.841	125.071
2	77.7108	77.9379	72.8977
3	63.6638	62.6886	56.3828
4	40.4996	40.2232	36.5059
5	30.5771	29.7324	25.7847
6	15.5416	15.0646	13.1971
7	11.0422	10.5198	9.61877



Scan Results



- From $cg = \pm 0.07$ to $cg = 0.03$

- Same conclusion with $C_{\tilde{B}W}$, C_{BB} , C_{BW} , C_{WW} operator

Comparison between different method

- Table for calculated **a**, **b**, **c** factor from *cgm* operator($cgm = \pm 1.2$)
 - Calculated from p_T^γ distribution

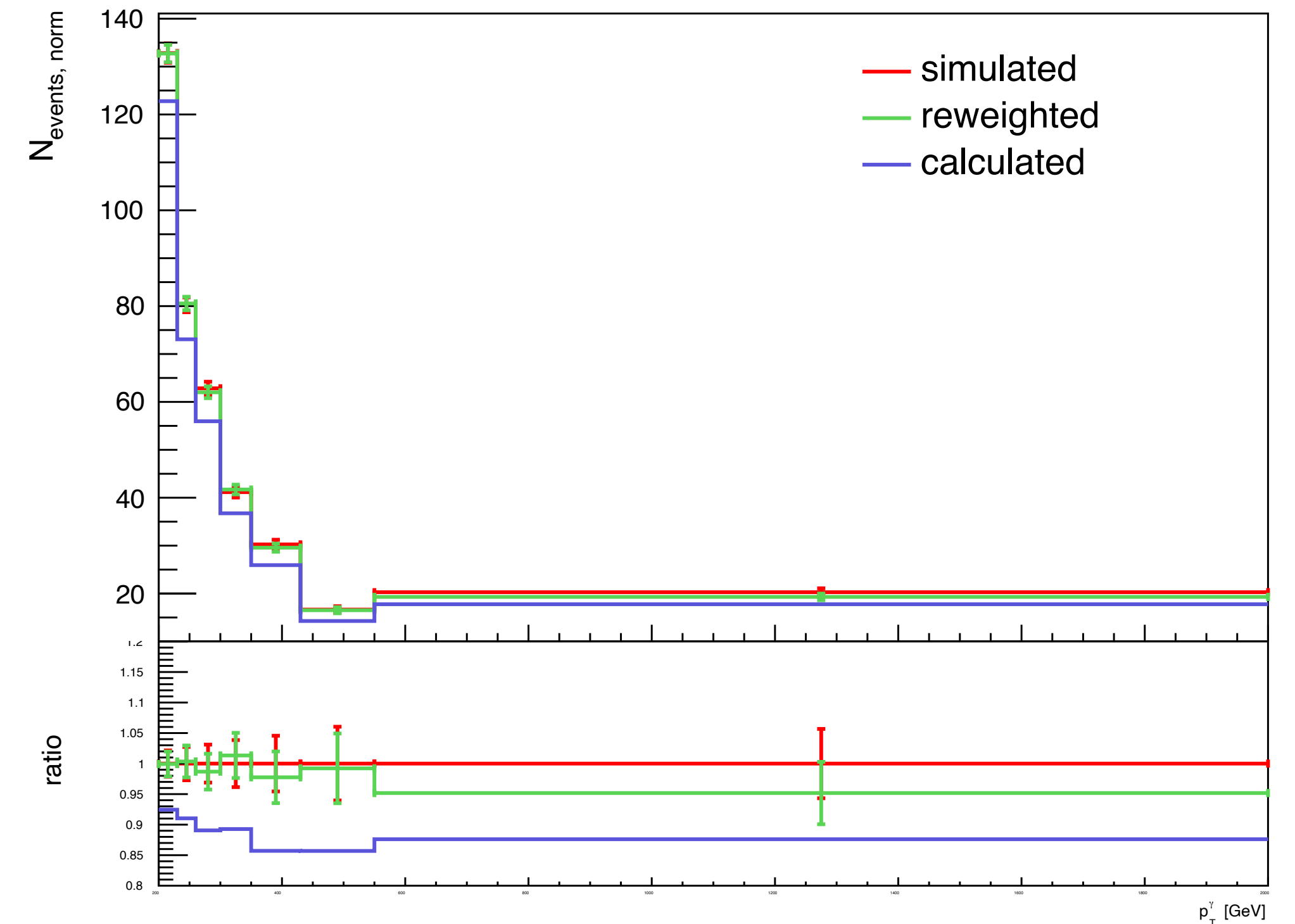
Bin index	a	b	c
1	5.65966	-0.267244	120.903
2	5.43576	-0.0917419	71.1677
3	4.39739	-0.175029	54.4834
4	4.2754	-0.235832	35.3501
5	4.25132	-0.309042	24.5852
6	4.99349	0.053787	12.4363
7	34.0295	-0.512892	5.82101

Comparison between different method

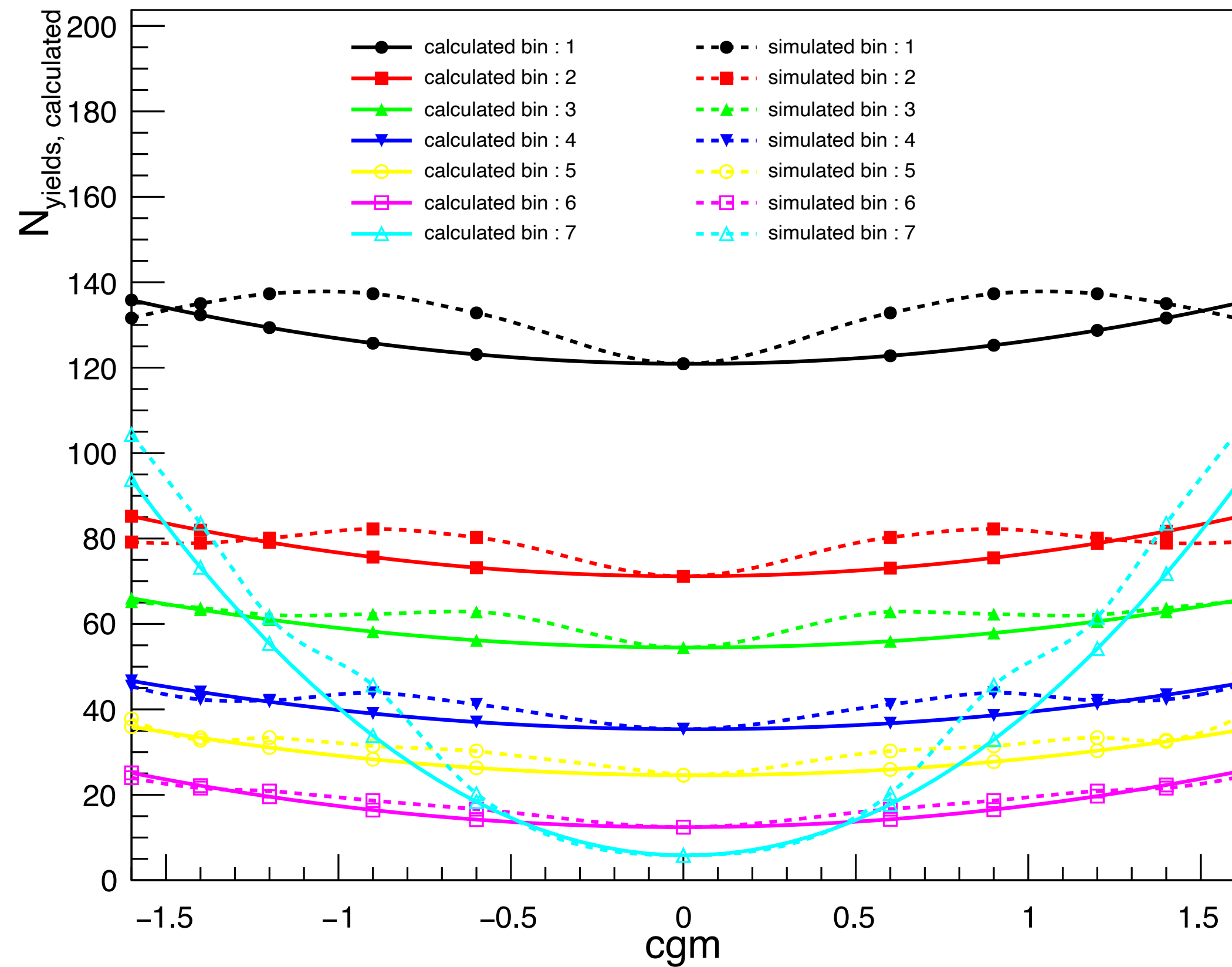
- Event yields comparison results for different method From $cgm = \pm 1.2$

To $cgm = 0.6$

Bin index	Simulated	Re-weighted	Calculated
1	132.811	132.718	122.78
2	80.2687	80.546	73.0695
3	62.8387	62.0088	55.9614
4	41.1619	41.7108	36.7477
5	30.254	29.5743	25.9303
6	16.6481	16.5177	14.2662
7	20.2759	19.2975	17.7639



Scan Results



- From $cgm = \pm 1.2$ to $cgm = 0.6$
- Same conclusion with $C_{\tilde{B}W}, C_{BB}, C_{BW}, C_{WW}, cg$ operators