

SIMC vs DATA Yield Comparison For SIDIS RUNS

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Calculation of Scale factor for Dummy Subtraction for Hydrogen and Deuterium Targets

Loop 2 : H₂ Target thickness , $T_{H_2} = 0.150 + 0.191 = 0.341 \text{ mm}$
Loop3 : D₂ Target thickness, $T_{D_2} = 0.130 + 0.188 = 0.318 \text{ mm}$
Al Dummy target mass density = $0.1816 + 0.1815 = 0.3631 \text{ gm/cm}^2$
Density of Al 7075 = 2.81 gm / cm^3
Hence, Thickness of Dummy target = $0.3631 / 2.81$
 $T_{al} = 0.1292 \text{ cm} \equiv 1.30 \text{ mm}$

Thickness Ratios :

$$T_{H_2} / T_{al} = 0.341 / 1.30 = 0.262307 \equiv 0.262$$
$$T_{D_2} / T_{al} = 0.318 / 1.30 = 0.2446154 \equiv 0.245$$

These ratios are Denoted by **dummy_factor** in the analysis.

Thus, we scale the Dummy data with the factor of **0.262** when subtracting from the H2 data and by a factor of **0.245** when subtracting from D2 data.

Hallc Targets

4 Target Thicknesses

4.1 Hydrogen loops

Entrance and exit window thicknesses are given below. Loop 1 is in standby with helium gas. Loop 2 is connected to the H2 panel and Loop 3 is connected to the D2 panel.

Target	Entrance (mm)	Exit (mm)	Length (mm)	Material
Loop 1 (4 cm)	0.165 ± 0.0019	0.151 ± 0.0053 Tip 0.151 ± 0.0097 Wall	40 ± 0.26	AL 7075
Loop 1 (10 cm)	0.104 ± 0.0025	0.133 ± 0.0096 Tip 0.162 ± 0.014 Wall	100 ± 0.26	AL 7075
Loop 2 (10 cm)	0.150 ± 0.011	0.191 ± 0.019 Tip 0.219 ± 0.018 wall	100 ± 0.26	AL 7075
Loop 3 (10 cm)	0.130 ± 0.012	0.188 ± 0.013 Tip 0.184 ± 0.017 wall	100 ± 0.26	AL 7075

4.2 Dummy Targets

The dummy targets are aluminum foils mounted on separate frames with foils located at Z positions corresponding to the cryotarget exit and entrance windows.

Target	Thickness Total (g/cm ²)	Material
4 cm Dummy	0.0789 ± 0.00014 0.0811 ± 0.00014	Al 7075
10 cm Dummy	0.1816 ± 0.0003 0.1815 ± 0.0003	Al 7075

Setting 3-4 : SHMS at +ve polarity : Setting 4-4 : SHMS at -Ve Polarity : $z = 0.35$, $pt = 0.04$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = \pm 1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 14^\circ$

Target	Run No	Charge (Q) mC	SHMS Tr. Eff. (1)	HMS Tr. Eff. (2)	Live Time (3)	Effective charge $Q_{eff} = Q * [(1)*(2)*(3)]$ mC	Sum of Charges for a Target
Al	3838	16.10	0.9747	0.9984	0.9094	14.25	
	3839	31.70	0.9751	0.9987	0.9102	28.10	42.35
LH2	3840	23.10	0.9744	0.9983	0.9230	20.74	
	3841	23.10	0.9746	0.9983	0.9210	20.70	
	3842	22.80	0.9747	0.9984	0.9210	20.43	61.87
LD2	3835	16.68	0.9752	0.9983	0.9231	14.99	
	3836	15.96	0.9753	0.9982	0.9228	14.34	
	3837	16.10	0.9752	0.9753	0.9282	14.21	43.54

Scale factor for **Dummy subtraction**, $(f_{H2}) = [Q_{eff,H2}] / [Q_{eff,Al}] * (\text{dummy factor})$

Hence, **Scale factor** for Dummy Runs = $[61.87/42.35]*0.262 = 0.383$
 (to be subtracted from H2 data histogram)

And For **Charge Normalization**, as we use 1 mC in Simc, so we make the same in Data by :

For H2 Data, for **charge Normalization**, $1 / [Q_{eff,H2}] = 1 / 61.87 = 0.0162$
 (to scale the H2 data to get normalized yield)

Similarly, Scale factor for D2 Runs = 0.252 and charge Normalization factor = 0.023

Setting 3-4 : SHMS at +ve polarity : Setting 4-4 : SHMS at -Ve Polarity : $z = 0.35$, $pt = 0.04$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = \pm 1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 14^\circ$

For Data

Thus, a clean Histogram consists of :

- 1) The raw histogram obtained from Data
- 2) With accidentals subtracted
- 3) With Dummy Subtracted
- 4) Charge Normalized (i.e. we have the histograms for **Yield per mc**)

For SIMC

Normfac for setting 3-4 = $0.138391E+12$

No. of Events Simulated = 500,000

Simc Factor = $0.138391E+12 / 500,000$

We weight the simc histogram by getting “weight” from Simc Leaf and then multiplying by Simc Factor, that is new weight is **wt = weight * Simc Factor**.

PID_CUTS:

SHMS : pion_cut : $P.aero.npeSum > 1.0 \ \&\& \ P.cal.eprtracknorm < 0.2$

HMS : electron_cut : $H.cer.npeSum > 1.0 \ \&\& \ H.cal.etottracknorm > 0.6$
 $\&\& \ H.cal.etottracknorm < 2.0 \ \&\& \ H.cal.eprtracknorm > 0.2$

Looking at Setting 3 -4, 3 -8 and 3 -12 with SHMS at Positive Polarity And 4 -4, 4 -8 and 4 -12 with SHMS at Negative Polarity

Kinematic Group 3

Kinematics: $x=0.31$, $Q^2=3.10$ GeV², $W=2.79$ GeV

HMS settings: $p=-5.27$ GeV, $\theta = 13.5$

SHMS polarity: **positive**

#	SHMS		z	pt	Hz/3	PTTrig6 LH2			approximate beam current			Goals and actual mC				Dummy		Done?
	P	Thet				LH2	LD2	Dum	LH2	LD2	Dum	goal	got	goal	got	goal	got	
1	1.96	8.0	0.35	-0.16	47.	4.1	2.0	9.1	37.	37.	26.	26.2	33.	33.2	done			done
2	1.96	10.0	0.35	-0.09	96.	6.1	3.0	13.5	44.	45.	31.	31.3	41.	41.7	done			done
3	1.96	12.0	0.35	-0.02	182.	9.2	4.6	20.4	55.	58.8	39.	39.7	50.	52.7	done			done
4	1.96	14.0	0.35	0.04	273.	14.2	7.1	31.6	68.	69.	48.	48.6	62.	63.4	done			done
5	1.96	16.0	0.35	0.11	359.	22.4	11.2	40.0	85.	85.	60.	61.	70.	70.	done			done
6	1.96	18.0	0.35	0.18	388.	35.9	17.9	40.0	108.	112.	77.	81.	70.	71.	done			done
7	1.96	20.0	0.35	0.25	587.	58.5	29.2	40.0	138.	141.	98.	101.	70.	70.	done			done
8	1.96	22.0	0.35	0.32	504.	60.0	48.4	40.0	140.	142.	126.	126.	70.	71.	done			done
9	1.96	24.0	0.35	0.39	303.	60.0	60.0	40.0	140.	141.	140.	141.	70.	71.	done			done
10	1.96	26.0	0.35	0.45	182.	60.0	60.0	40.0	140.	141.	140.	141.	70.	73.	done			done
11	1.96	28.0	0.35	0.52	109.	60.0	60.0	40.0	140.	147.	140.	146.	70.	81.	done			done
12	1.96	30.0	0.35	0.58	64.	60.0	60.0	40.0	140.	150.	140.	140.	70.	80.	done			done

Kinematic Group 4

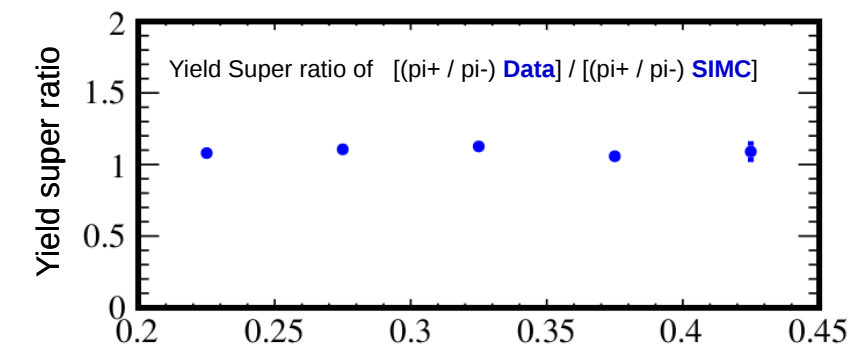
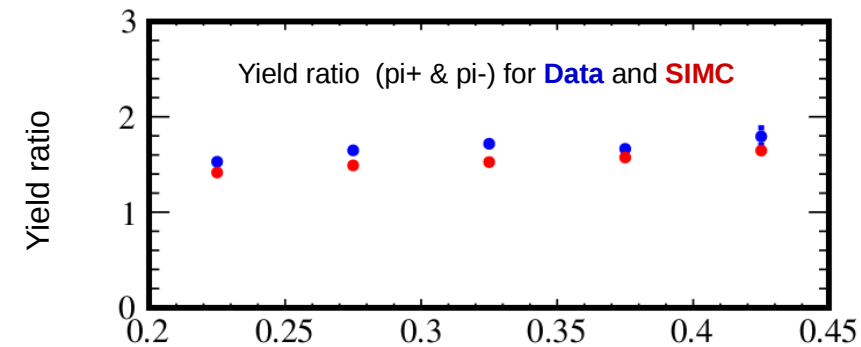
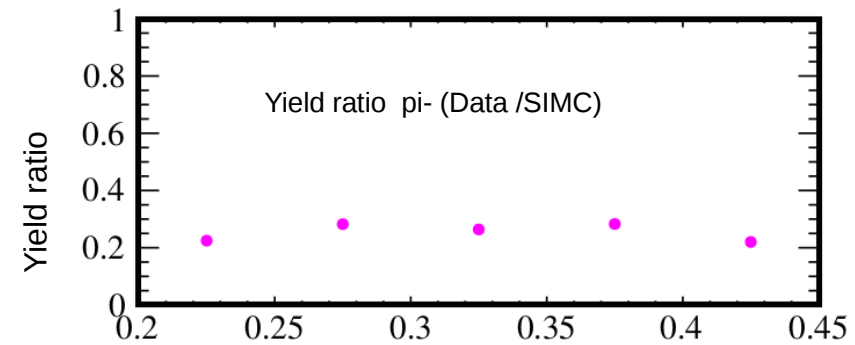
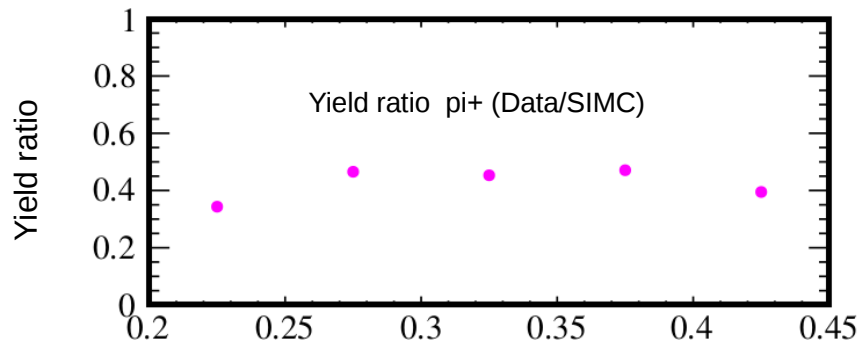
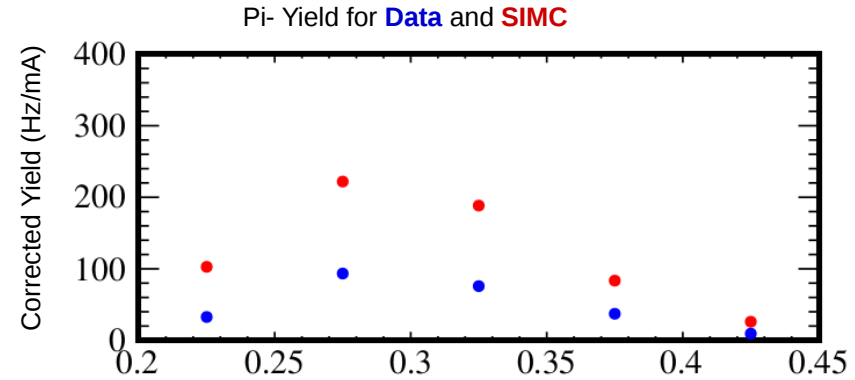
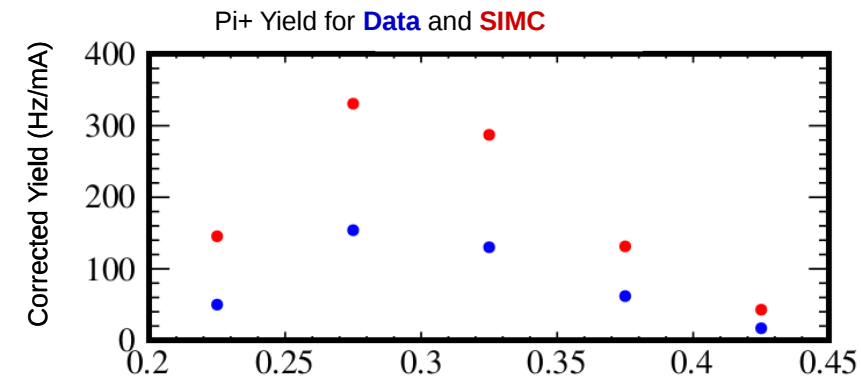
Kinematics: $x=0.31$, $Q^2=3.10$ GeV², $W=2.79$ GeV

HMS settings: $p=-5.27$ GeV, $\theta = 13.5$

SHMS polarity: **negative**

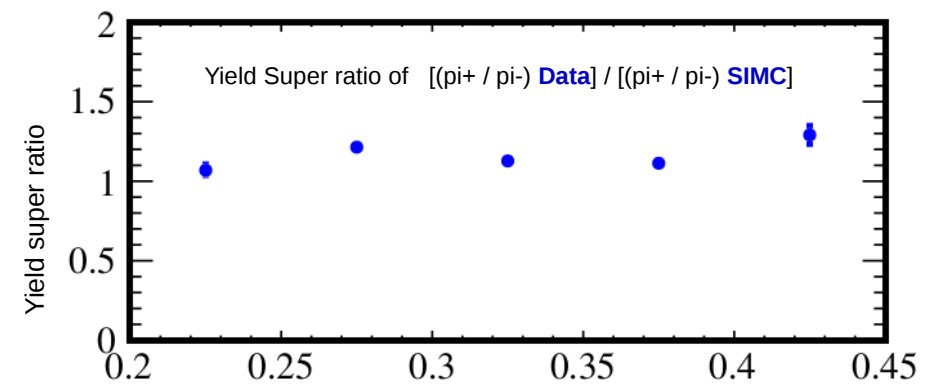
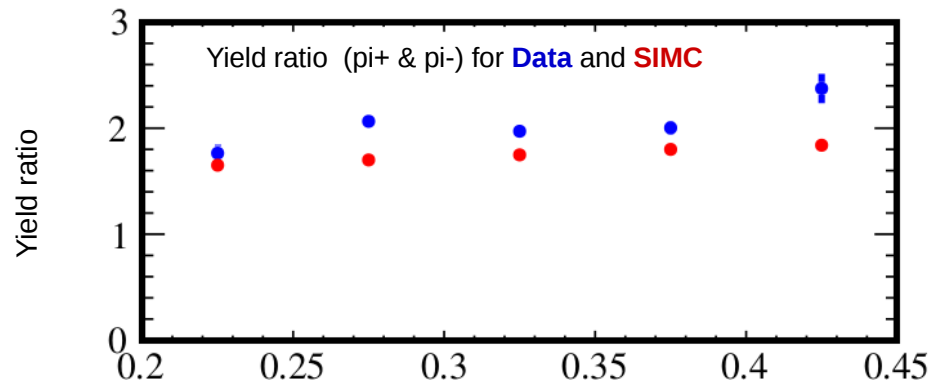
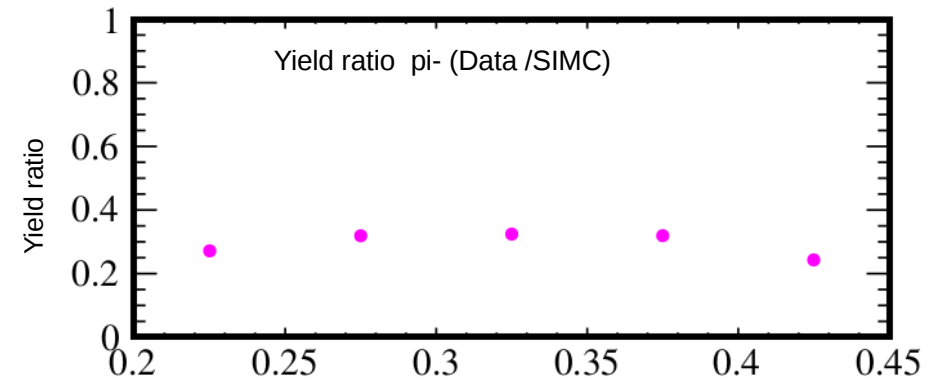
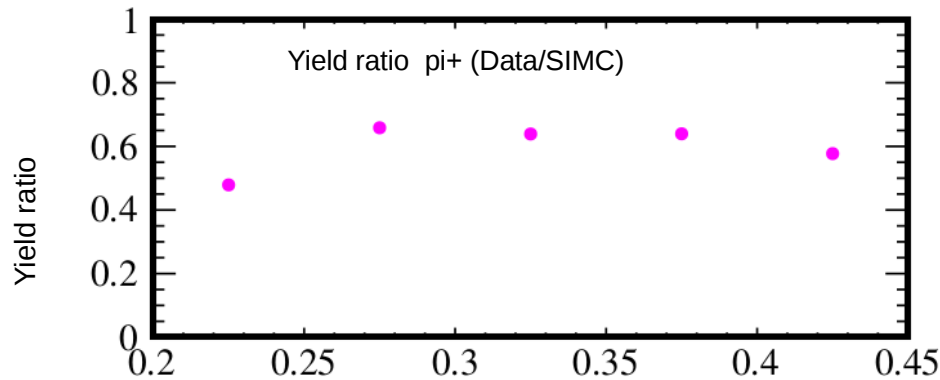
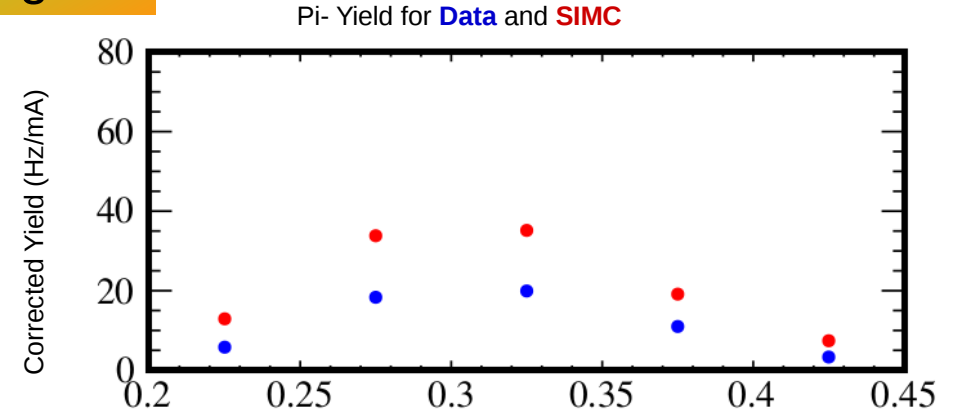
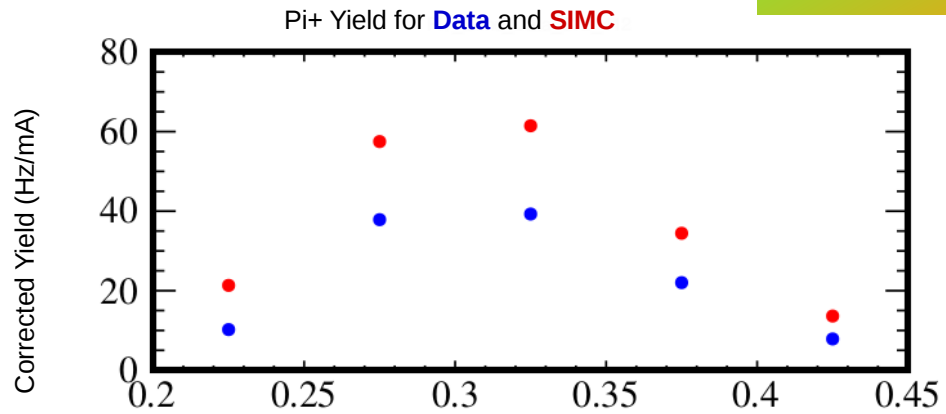
#	SHMS		z	pt	Hz/3	PTTrig6 LH2			approximate beam current			Goals and actual mC				Dummy		Done?
	P	Thet				LH2	LD2	Dum	LH2	LD2	Dum	goal	got	goal	got	goal	got	
1	-1.96	8.0	0.35	-0.16	47.	4.1	2.0	9.1	37.	37.9	26.	27.8	33.	34.6	done			done
2	-1.96	10.0	0.35	-0.09	96.	6.1	3.0	13.5	44.	45.3	31.	31.	41.	43.7	done			done
3	-1.96	12.0	0.35	-0.02	182.	9.1	4.6	20.3	55.	56.0	39.	39.9	50.	51.3	done			done
4	-1.96	14.0	0.35	0.04	273.	14.0	7.1	31.4	68.	69.0	48.	48.2	62.	62.8	done			done
5	-1.96	16.0	0.35	0.11	359.	20.7	11.1	40.0	82.	82.2	60.	43.4	70.	70.8	done			done
6	-1.96	18.0	0.35	0.18	388.	29.1	17.8	40.0	98.	99.4	76.	75.7	70.	71.37	done			done
7	-1.96	20.0	0.35	0.25	587.	46.3	29.1	40.0	123.	124.9	97.	98.4	70.	74.37	done			done
8	-1.96	22.0	0.35	0.32	504.	60.0	48.1	40.0	140.	141.5	125.	125.3	70.	78.9	done			done
9	-1.96	24.0	0.35	0.39	303.	60.0	60.0	40.0	140.	141.8	140.	142.4	70.	72.8	done			done
10	-1.96	26.0	0.35	0.45	182.	60.0	60.0	40.0	140.	145.4	140.	142.6	70.	72.5	done			done
11	-1.96	28.0	0.35	0.52	109.	60.0	60.0	40.0	140.	146.0	140.	144.0	70.	79.0	done			done
12	-1.96	30.0	0.35	0.58	64.	60.0	60.0	40.0	140.	144.0	140.	141.0	70.	89.0	done			done

H2 target



Setting 3-4 : SHMS at +ve polarity : Setting 4-4 : SHMS at -Ve Polarity : $z = 0.35$, $pt = 0.04$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = \pm 1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 14^\circ$

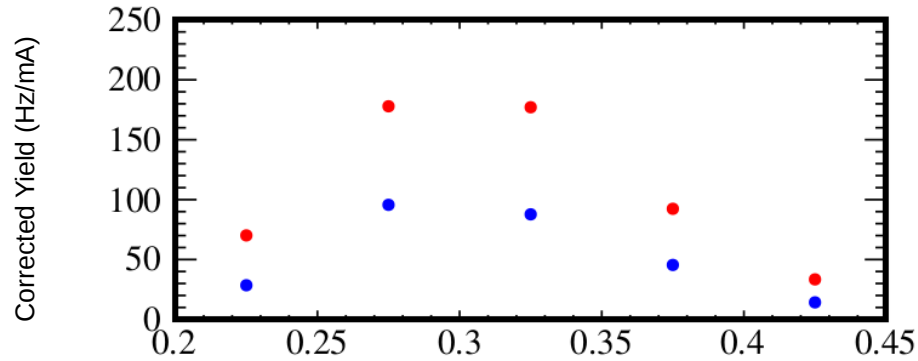
D2 Target



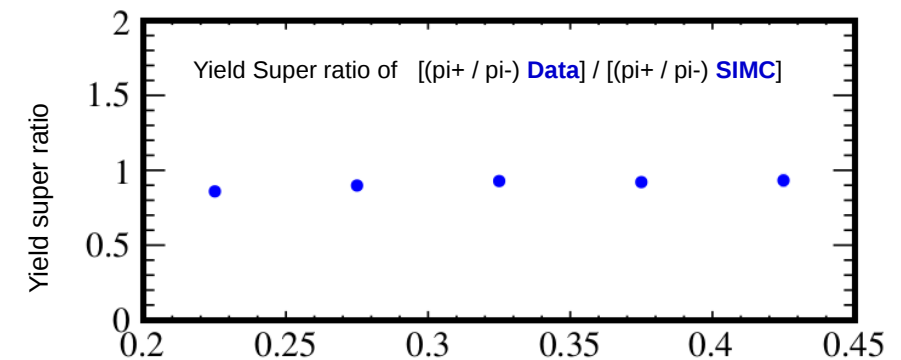
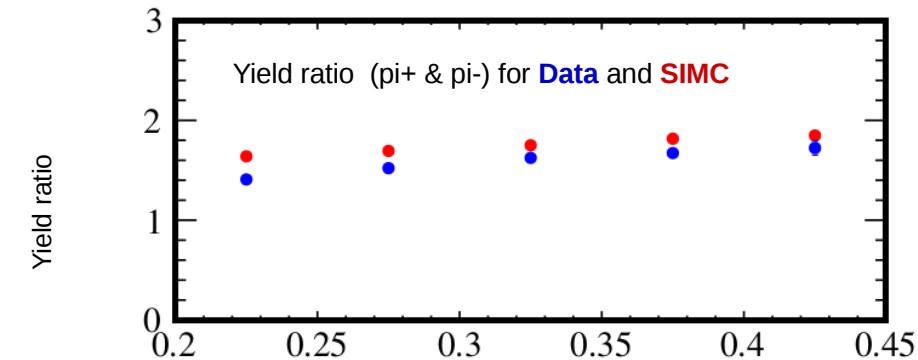
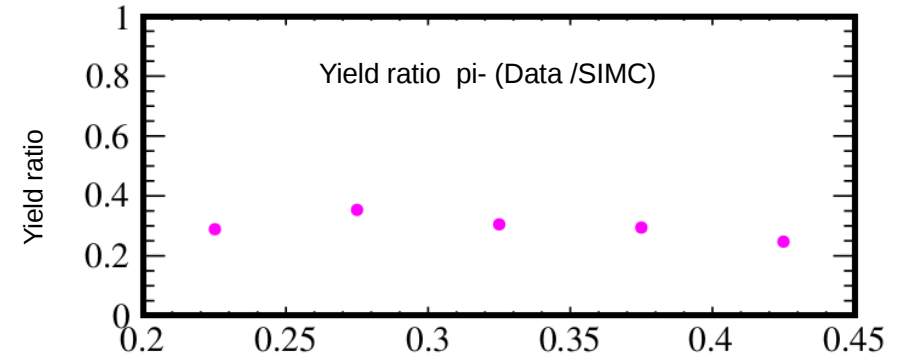
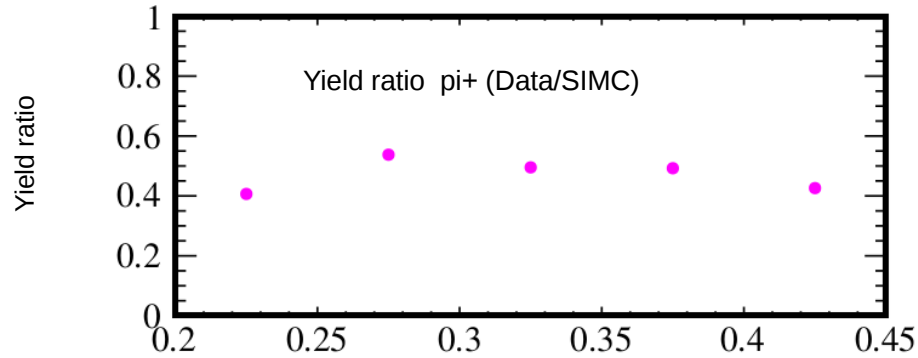
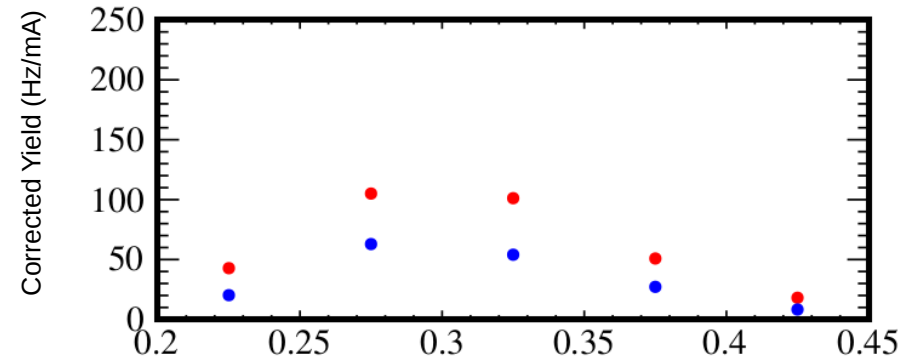
x_{Bj}

H2 target

Pi+ Yield for **Data** and **SIMC**

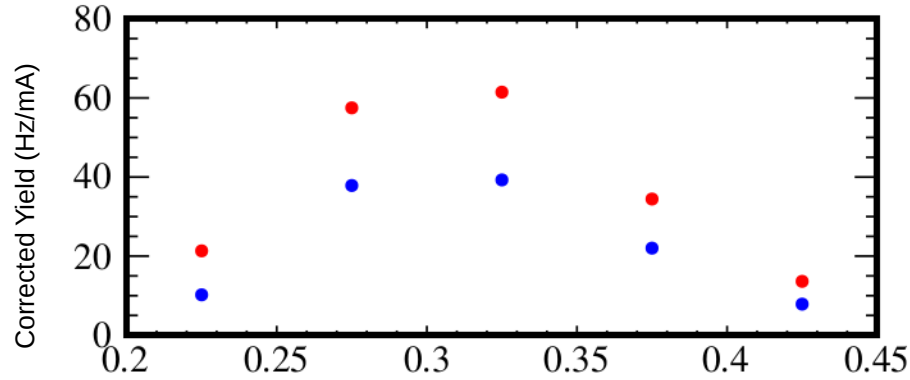


Pi- Yield for **Data** and **SIMC**

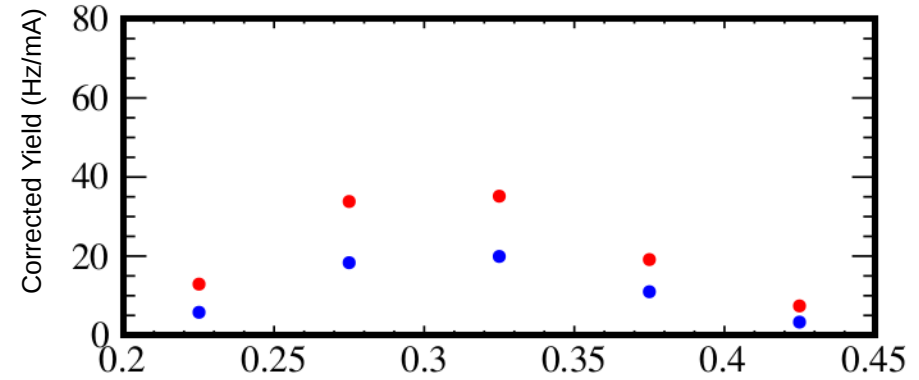


H2 target

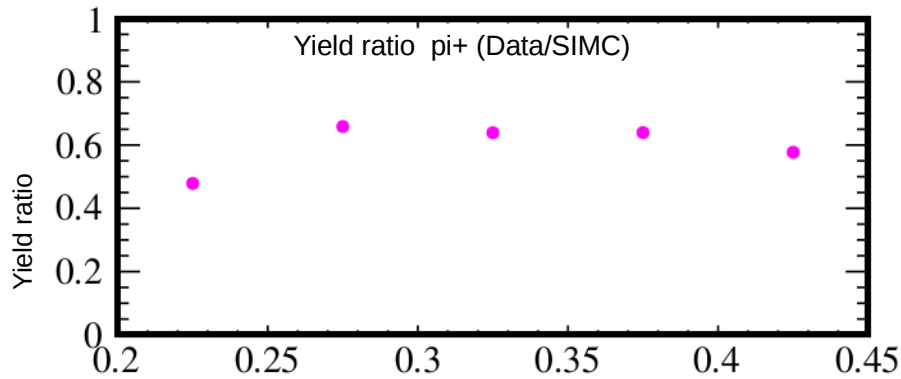
Pi+ Yield for Data and SIMC



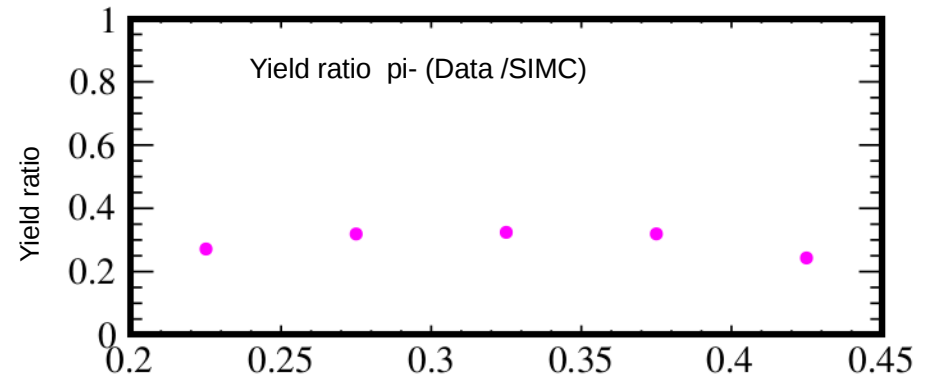
Pi- Yield for Data and SIMC



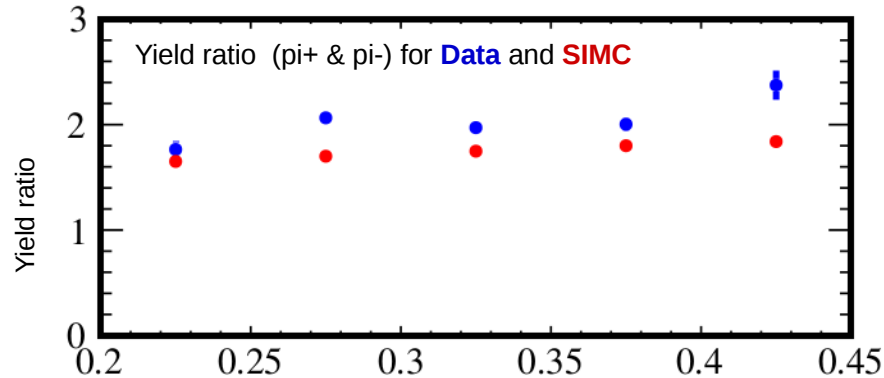
Yield ratio pi+ (Data/SIMC)



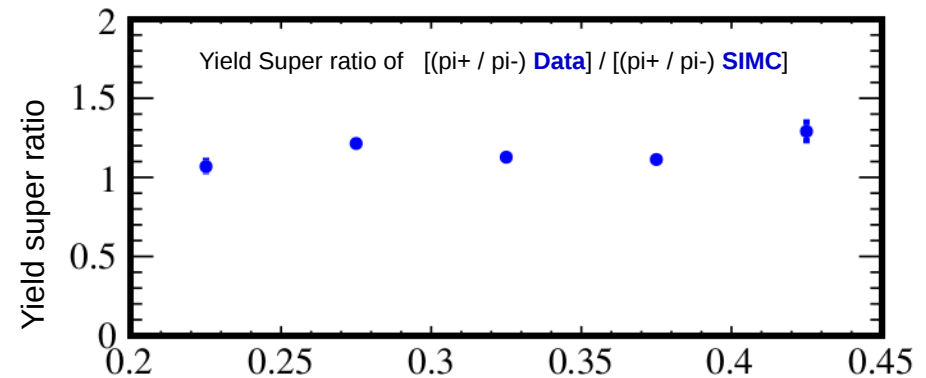
Yield ratio pi- (Data /SIMC)



Yield ratio (pi+ & pi-) for Data and SIMC



Yield Super ratio of [(pi+ / pi-) Data] / [(pi+ / pi-) SIMC]



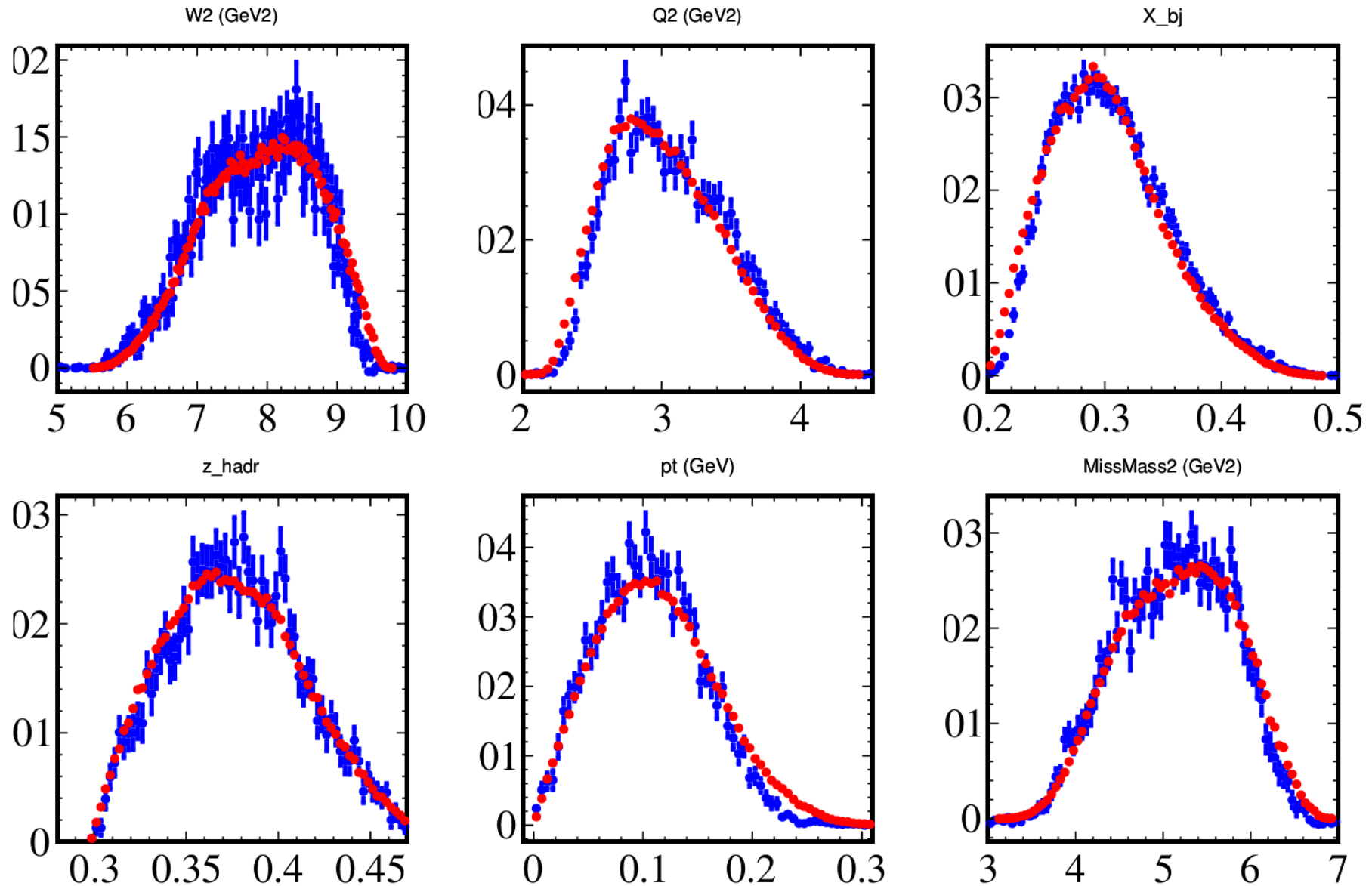
X_{Bj}

DATA and SIMC Comparison for various Kinematics Quantities After Subtracting Dummy Target Contribution

kinem. settings	Target	SHMS Polarity	Pt GeV/C	
3-4	H2	+ve	0.04	
3-4	D2	+ve	0.04	
4-4	H2	-ve	0.04	
3-8	H2	+ve	0.32	
4-8	H2	-ve	0.32	
3-12	H2	+ve	0.58	
4-12	H2	-ve	0.58	

Setting 3-4 : SHMS at +ve polarity : $z = 0.35$, $pt = 0.04$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = +1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 14^\circ$

H2 target

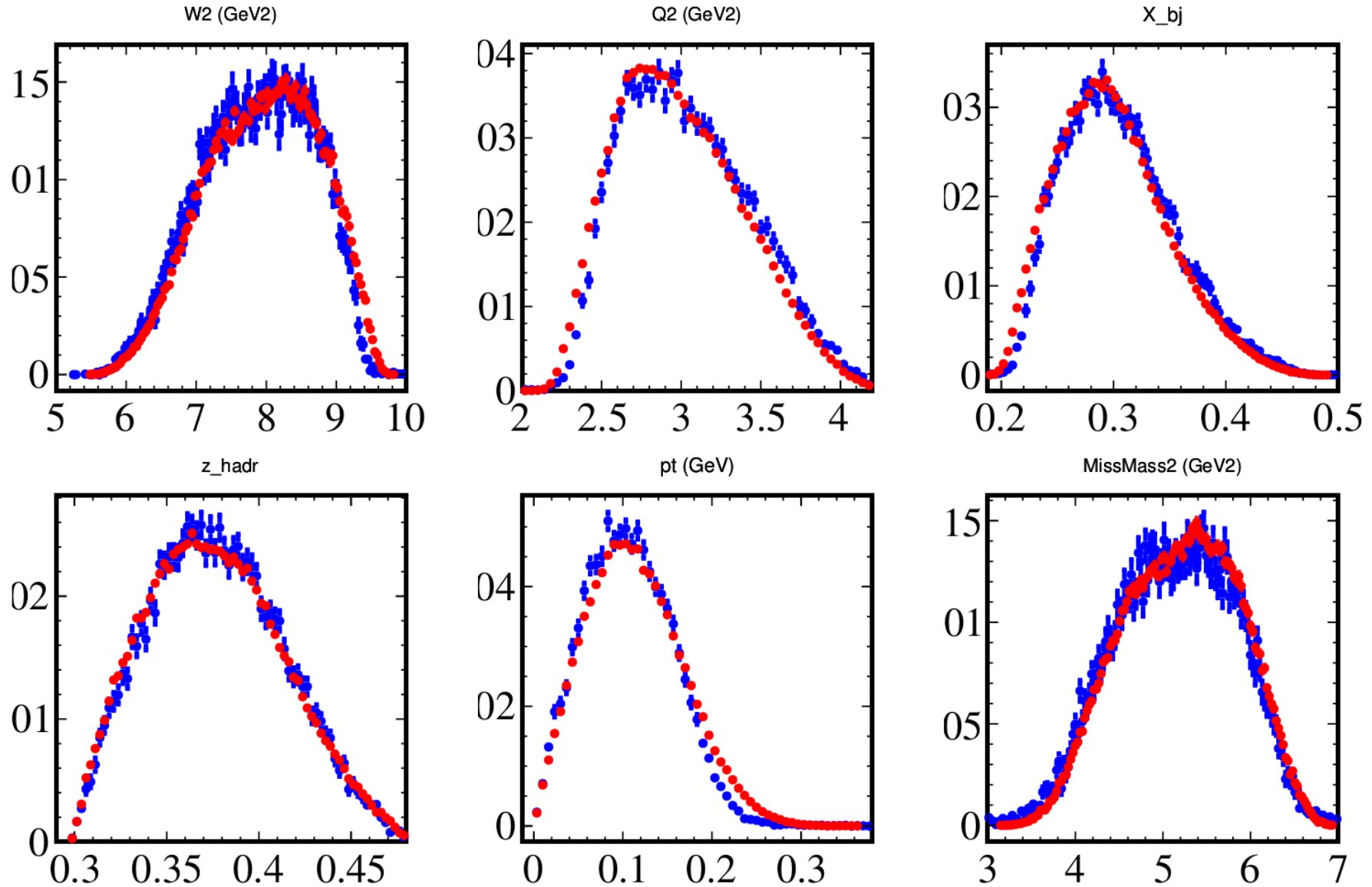


Data

Simc

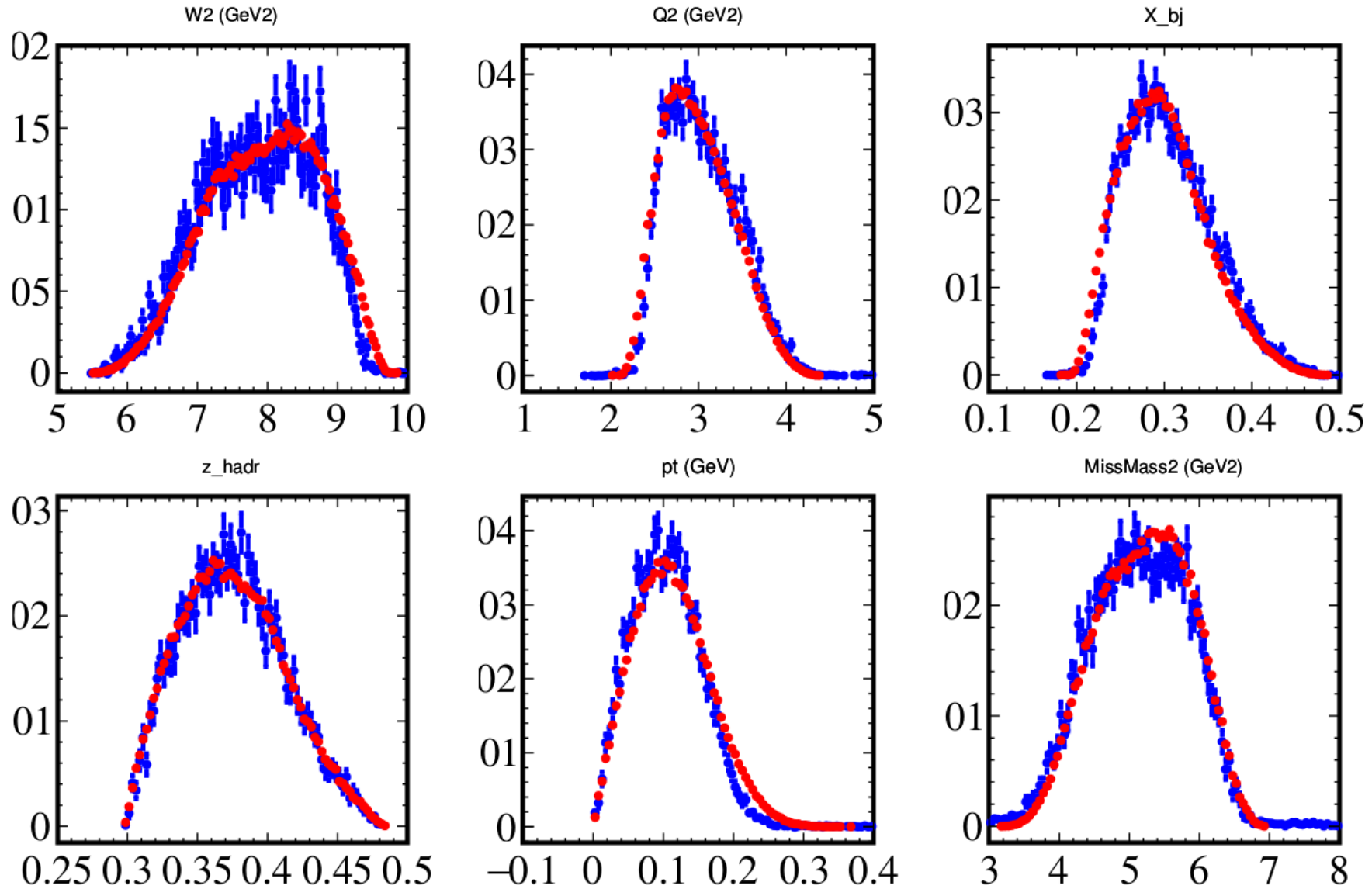
Setting 3-4 : SHMS at +ve polarity : $z = 0.35$, $pt = 0.04$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = +1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 14^\circ$

D2 Target



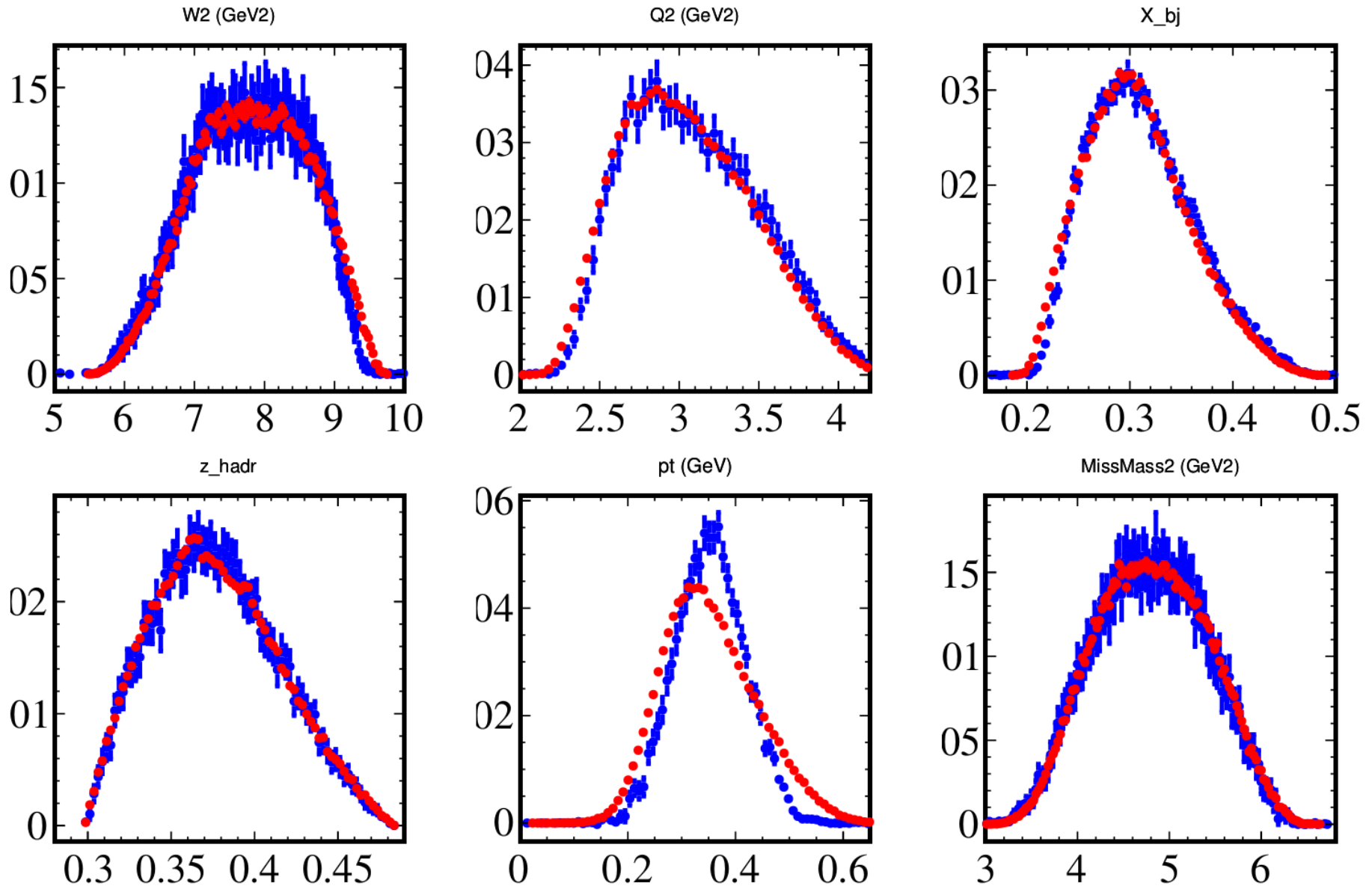
Setting 4-4 : SHMS at -Ve Polarity : $z = 0.35$, $pt = 0.04$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = -1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 14^\circ$

H2 target



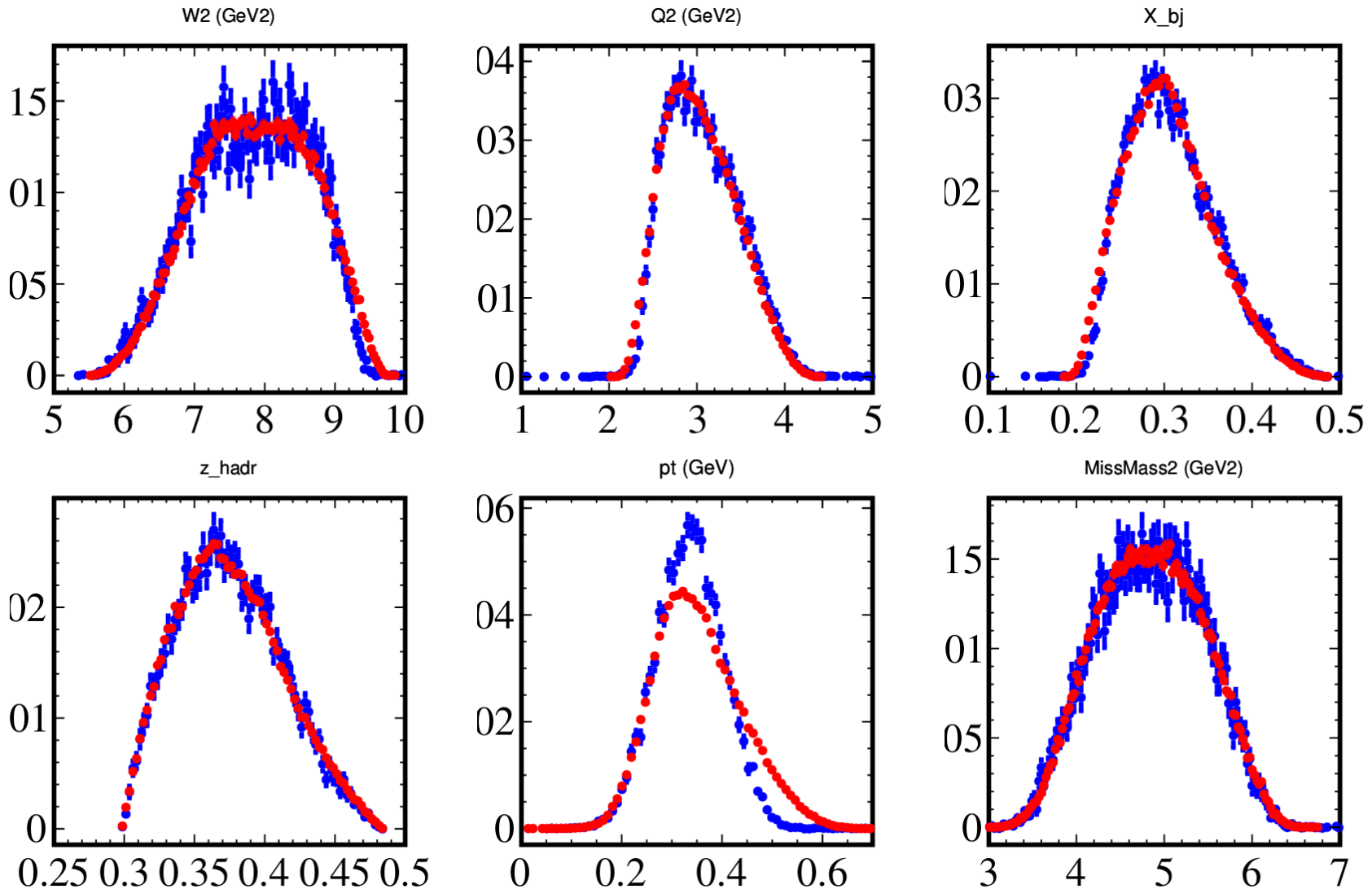
Setting 3-8 : SHMS at +ve polarity : $z = 0.35$, $pt = 0.32$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = +1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 22^\circ$

H2 target



Setting 4-8 : SHMS at -Ve Polarity : $z = 0.35$, $pt = 0.32$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = -1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 22^\circ$

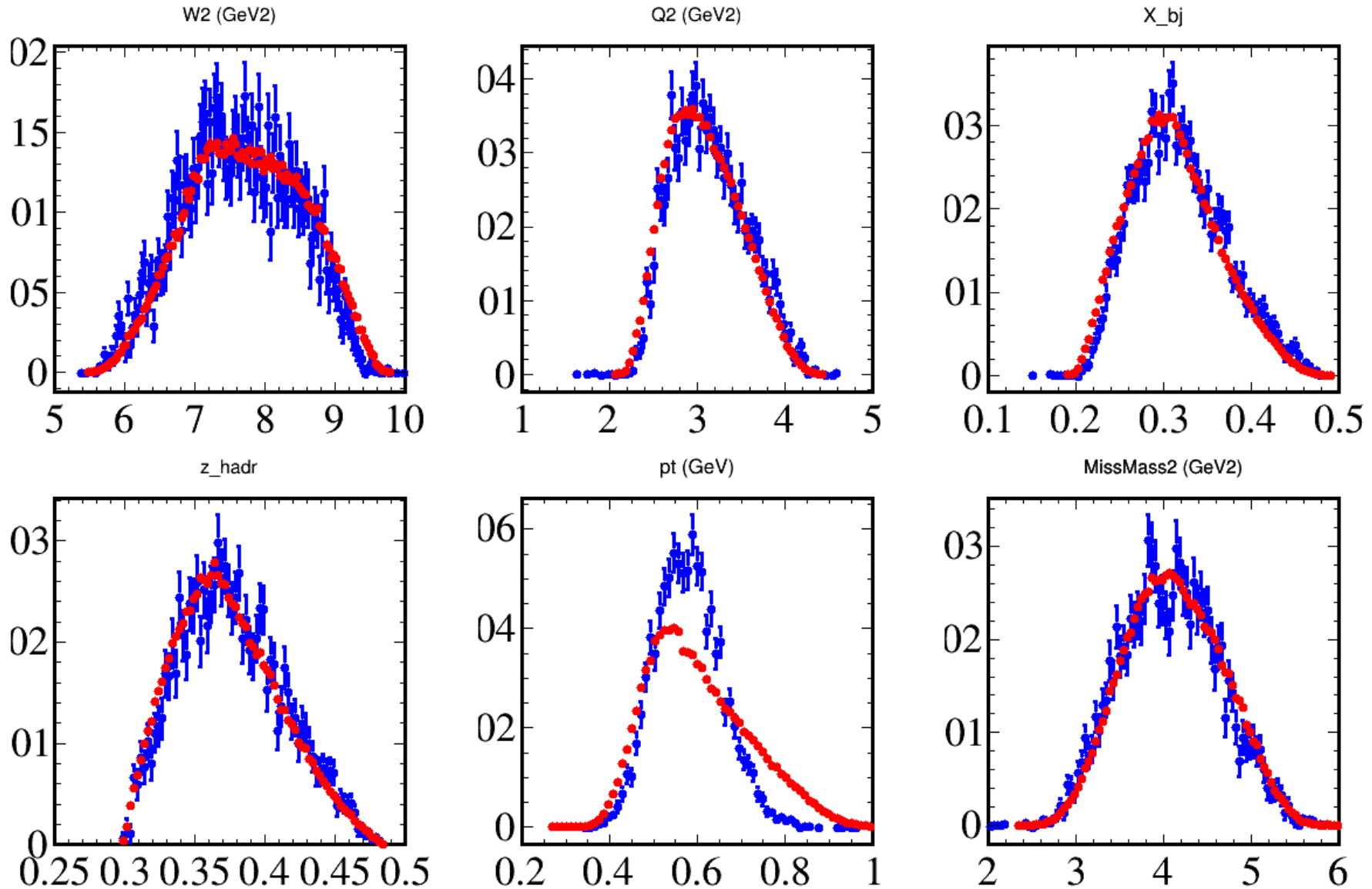
H2 target



Data

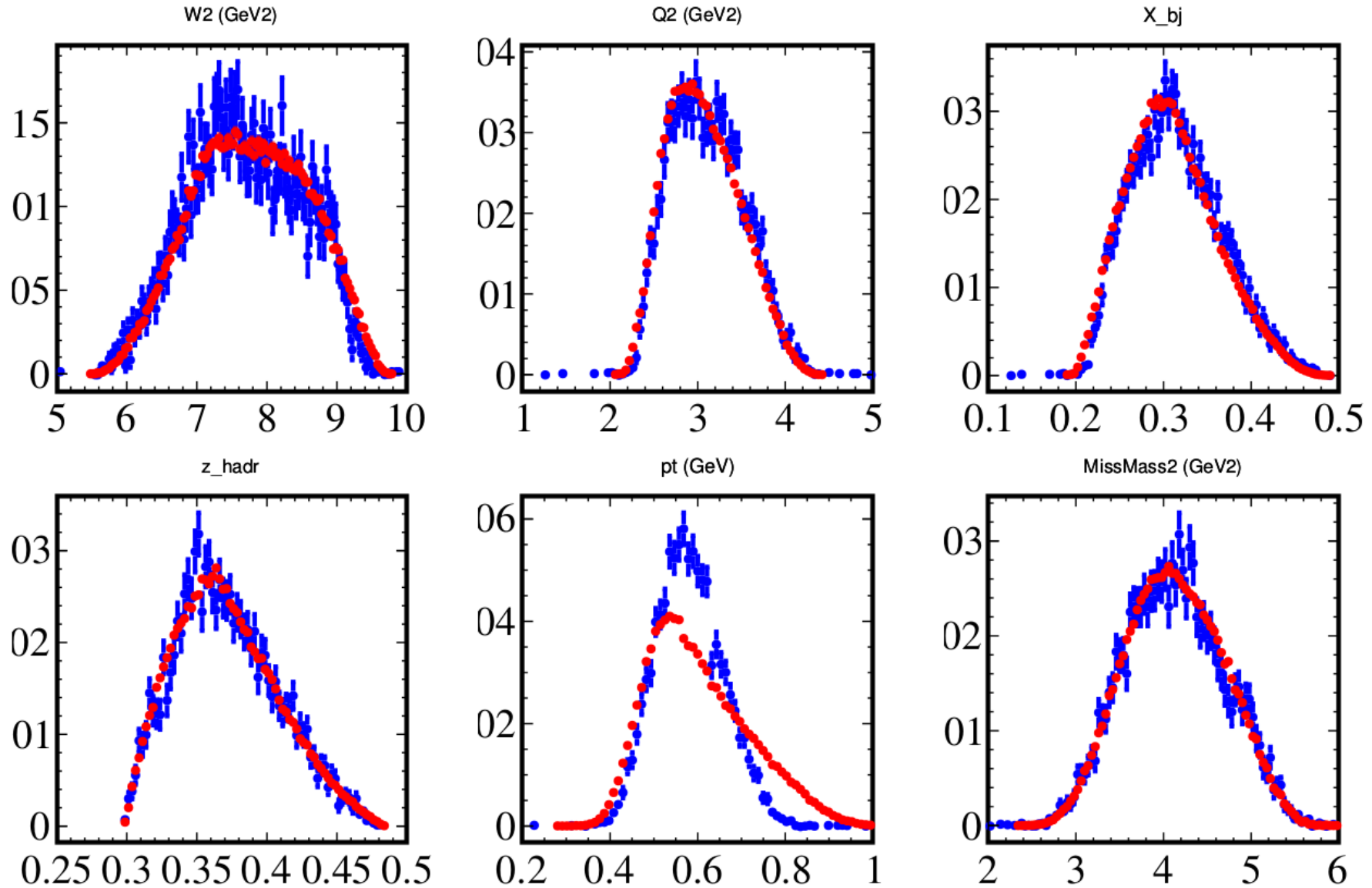
Simc

H2 target



Setting 4-12 : SHMS at -Ve Polarity : $z = 0.35$, $pt = 0.58$ GeV
 $x = 0.31$, $Q^2 = 3.10$ GeV², $P_{hms} = -5.27$ GeV, $P_{shms} = -1.96$ GeV, $\Theta_{hms} = 13.5^\circ$, $\Theta_{shms} = 30^\circ$

H2 target



Data

Simc