Detector induced assymetry in CP violation measurements

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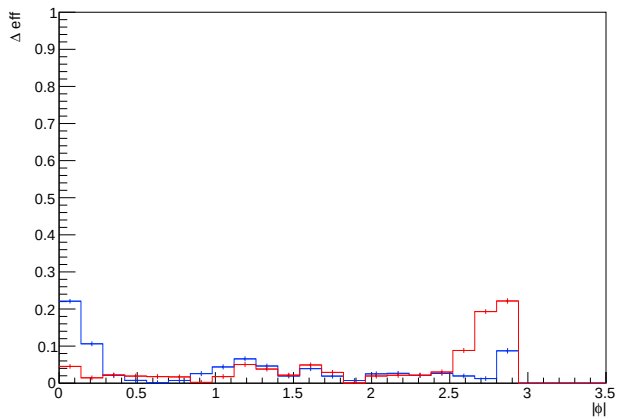
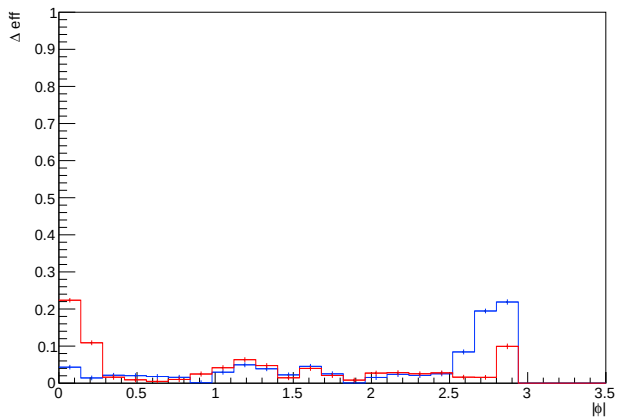
- normalization ($N_{tot} = 3 \cdot 10^6$) has no measurable effect
- mean origin vertex:
  - UP: $(0.84 \pm 0.03, -0.18 \pm 0.03, -2.64 \pm 44.56)$
  - DOWN: $(0.84 \pm 0.03, -0.18 \pm 0.03, -3.14 \pm 37.46)$
- x and y many σ from 0

  $\rightarrow$ asymmetric distribution of particles flying into the detector

Idea 1

- form of detector: difference in eff. of different charges with $\pm\phi$
- for $|\phi| < 0.5 \& |\phi| > 2.5$ big differences in reconstruction for both charges
  $\rightarrow$ cut these out





Total Efficiencies - before cut

Polarity	ϵ_π	ϵ_K	$\epsilon_{\pi,s}$	ϵ_{D^0}	ϵ_{D^*}
UP	86.65 ± 0.01	84.63 ± 0.01	76.65 ± 0.02	73.34 ± 0.02	56.31 ± 0.02
DOWN	86.68 ± 0.01	84.67 ± 0.01	76.66 ± 0.02	73.39 ± 0.02	56.35 ± 0.02

Total Efficiencies - after cut

Polarity	ϵ_π	ϵ_K	$\epsilon_{\pi,s}$	ϵ_{D^0}	ϵ_{D^*}
UP	86.65 ± 0.01	84.63 ± 0.01	50.23 ± 0.02	73.34 ± 0.02	36.61 ± 0.02
DOWN	86.68 ± 0.01	84.67 ± 0.01	50.25 ± 0.02	73.39 ± 0.02	36.58 ± 0.02

Charge: +

Numbers - before cut

UP	π	K	*soft* π	D^0	D^*
N_{reco}	2 669 990	2 620 280	2 352 910	2 249 370	1 720 940
N_{tot}	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000

DOWN	π	K	*soft* π	D^0	D^*
N_{reco}	2 674 000	2 626 350	2 374 360	2 253 370	1 737 460
N_{tot}	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000

Numbers - after cut

UP	π	K	*soft* π	D^0	D^*
N_{reco}	2 669 990	2 620 280	1 546 670	2 249 370	1 121 530
N_{tot}	3 000 000	3 000 000	1 961 330	3 000 000	1 961 330

DOWN	π	K	*soft* π	D^0	D^*
N_{reco}	2 674 000	2 626 350	1 552 010	2 253 370	1 125 280
N_{tot}	3 000 000	3 000 000	1 963 510	3 000 000	1 963 510

Charge: -

Numbers - before cut

UP	π	K	*soft* π	D^0	D^*
N_{reco}	2 669 990	2 620 280	2 352 910	2 249 370	1 720 940
N_{tot}	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000

DOWN	π	K	*soft* π	D^0	D^*
N_{reco}	2 674 000	2 626 350	2 374 360	2 253 370	1 737 460
N_{tot}	3 000 000	3 000 000	3 000 000	3 000 000	3 000 000

Numbers - after cut

UP	π	K	*soft* π	D^0	D^*
N_{reco}	2 669 990	2 620 280	1 549 090	2 249 370	1 132 970
N_{tot}	3 000 000	3 000 000	1 960 630	3 000 000	1 960 630

DOWN	π	K	*soft* π	D^0	D^*
N_{reco}	2 674 000	2 626 350	1 549 160	2 253 370	1 134 370
N_{tot}	3 000 000	3 000 000	1 964 560	3 000 000	1 964 560

Deviation before & after cut

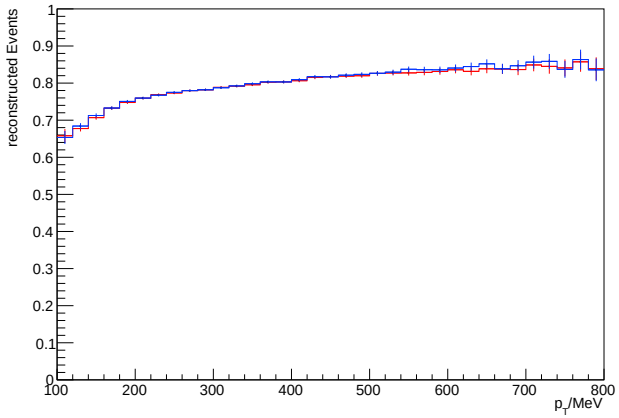
Table: The deviation $\frac{N_+ - N_-}{N_+ + N_-} / 10^{-3}$

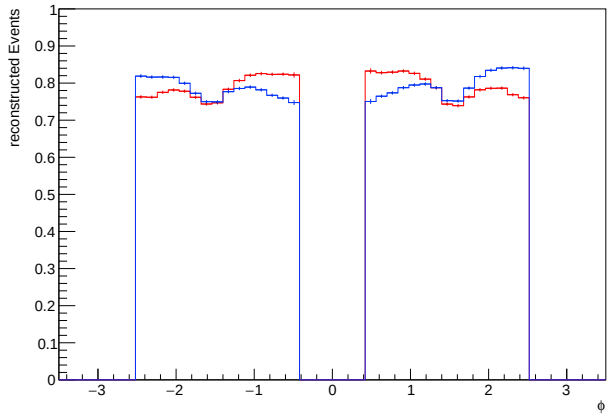
Polarity	π	K	$soft\pi$	D^0	D^*
UP	-0.1 ± 0.4	4.7 ± 0.4	-3.8 ± 0.5	-4.7 ± 0.5	-8.2 ± 0.5
DOWN	-0.3 ± 0.4	5.2 ± 0.4	3.7 ± 0.5	-5.0 ± 0.5	-0.8 ± 0.5

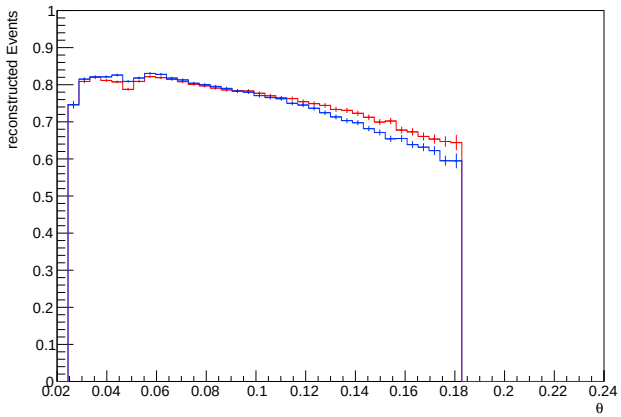
Polarity	π	K	$soft\pi$	D^0	D^*
UP	-0.1 ± 0.4	4.7 ± 0.4	-0.8 ± 0.6	-4.7 ± 0.5	-5.1 ± 0.7
DOWN	-0.3 ± 0.4	5.2 ± 0.4	0.9 ± 0.5	-5.0 ± 0.5	-4.0 ± 0.7

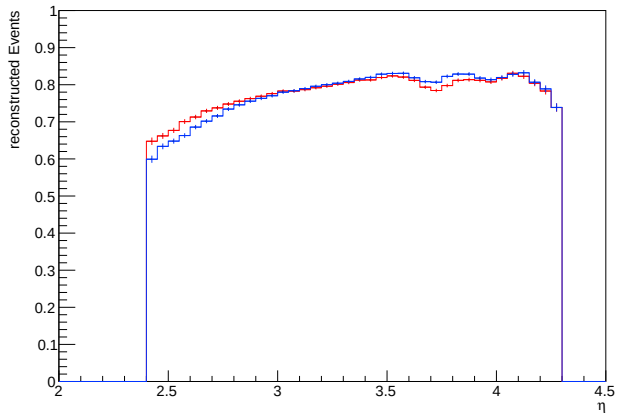
- deviation in π gets smaller, in D^* equals out
- $\approx 35\%$ of events is rejected

Comparison of different charges with *UP* polarity - soft π

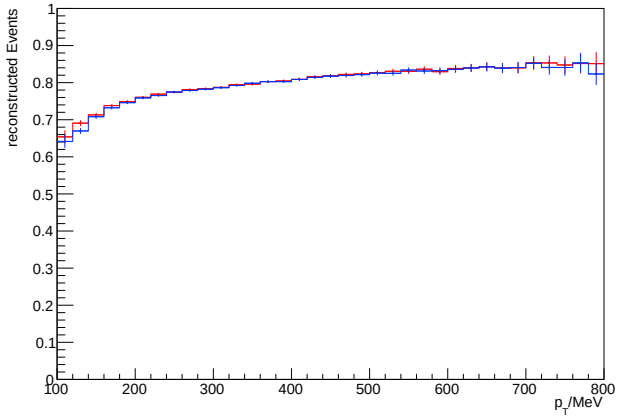


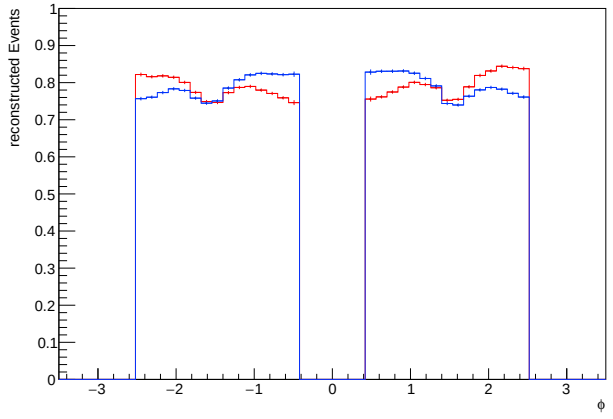


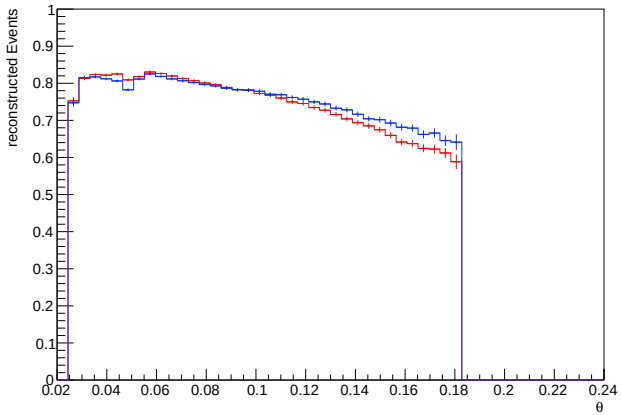


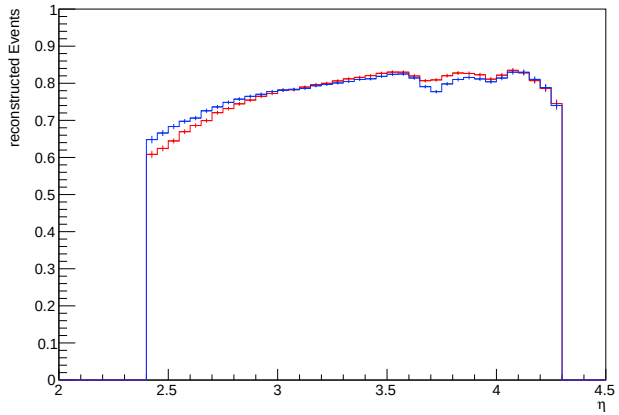


Comparison of different charges with *DOWN* polarity - soft π

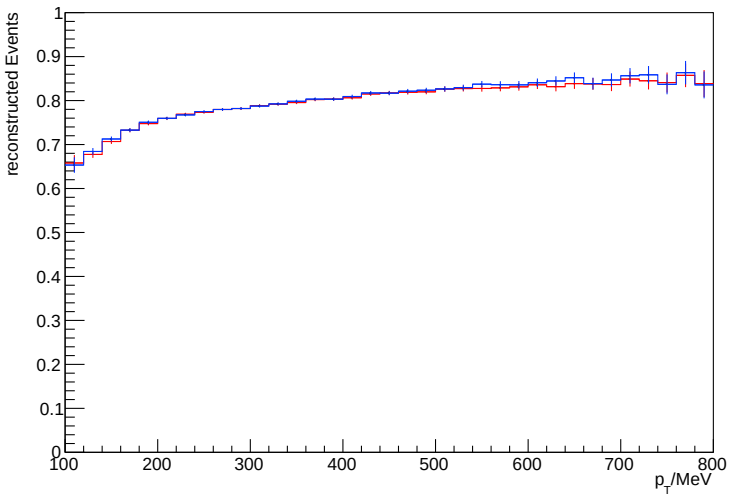


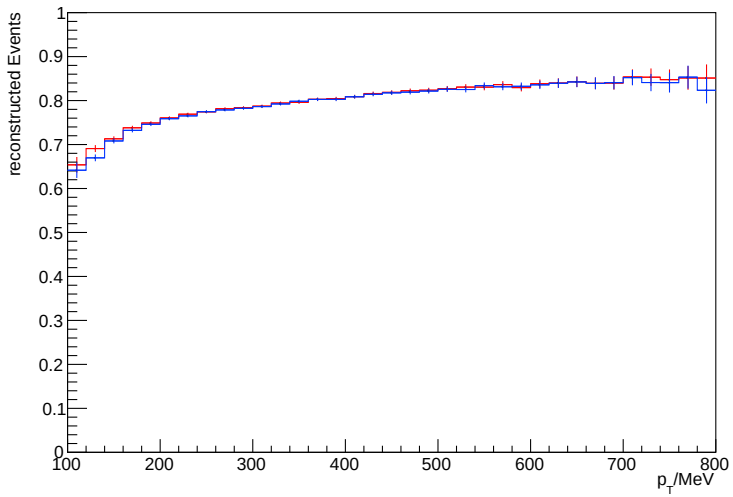




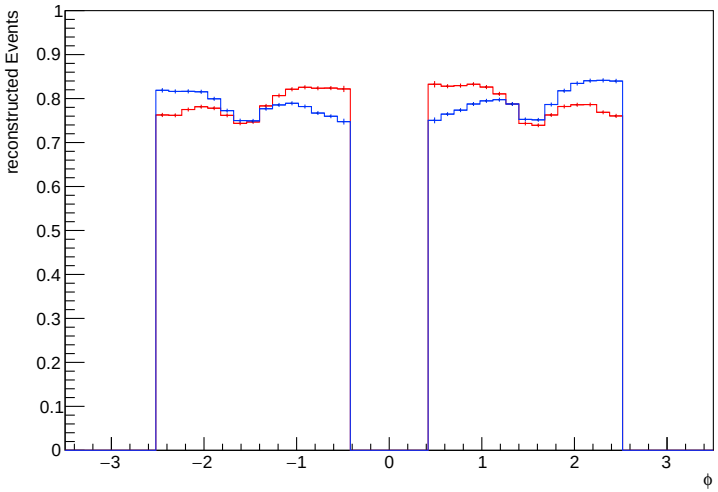


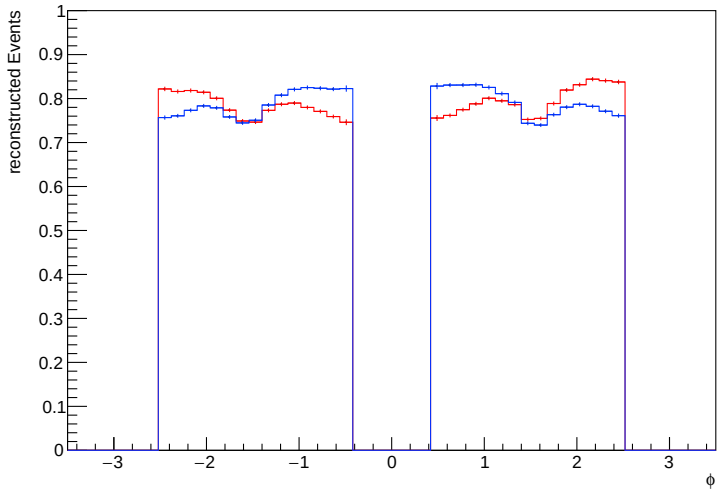
Comparison - soft πp_T



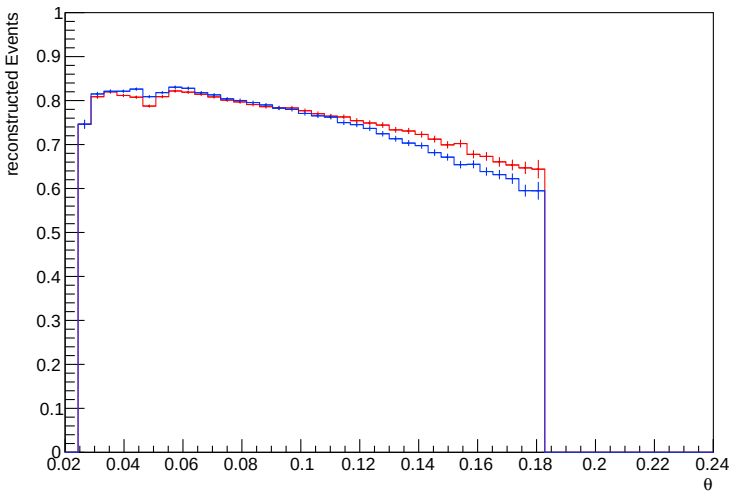


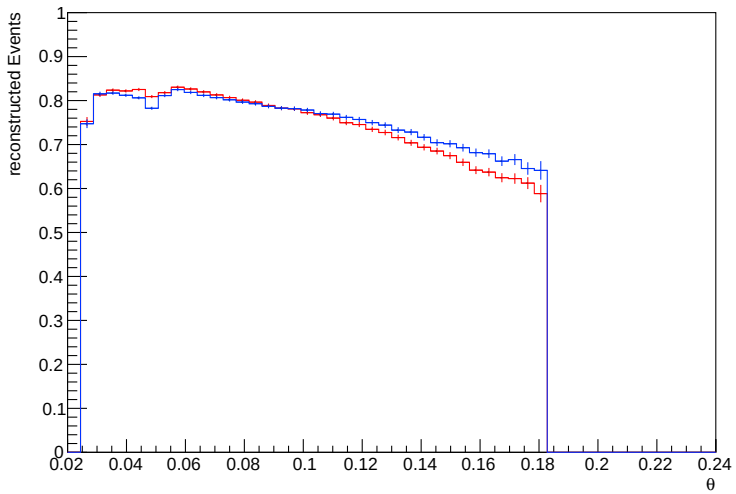
Comparison - soft $\pi\phi$



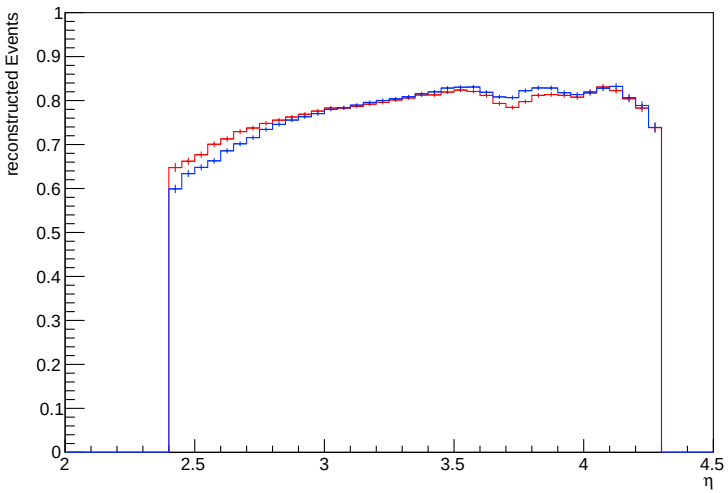


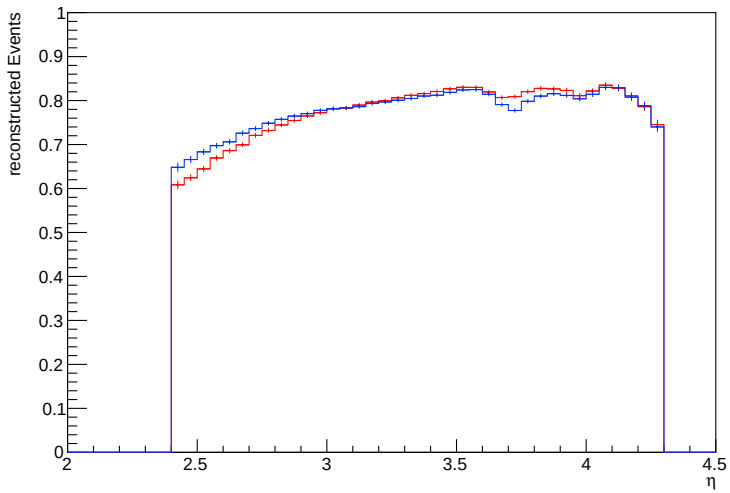
Comparison - soft $\pi\theta$



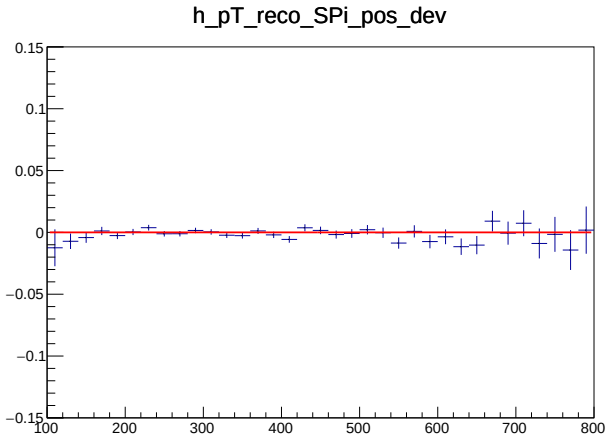


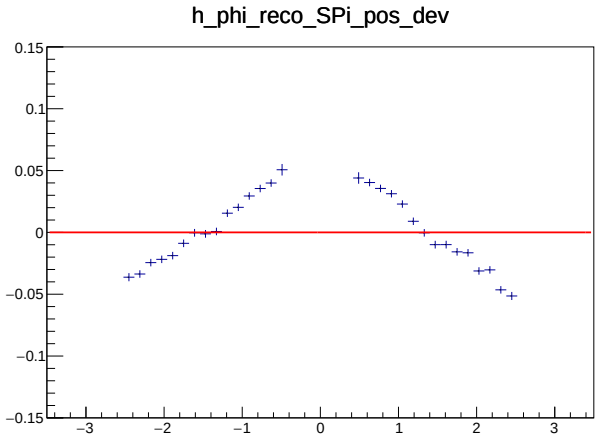
Comparison - soft $\pi\eta$

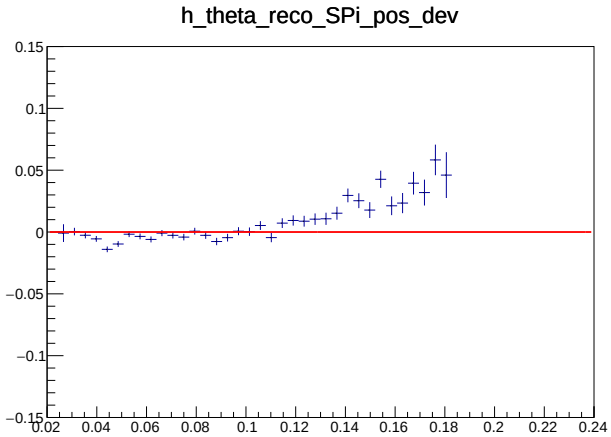


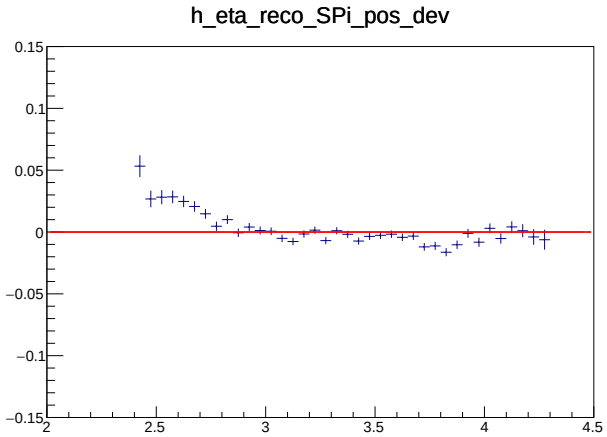


soft π deviation dependencies - *UP* polarity

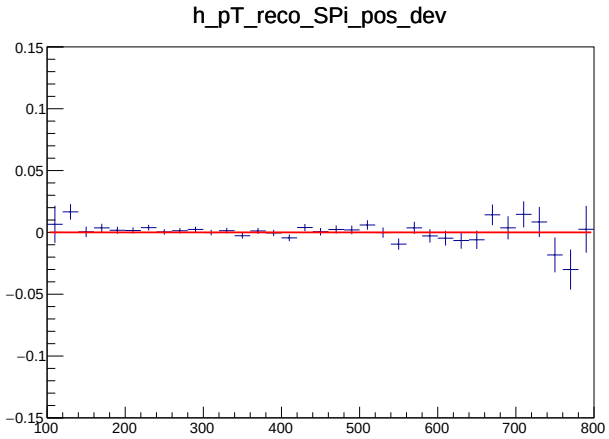


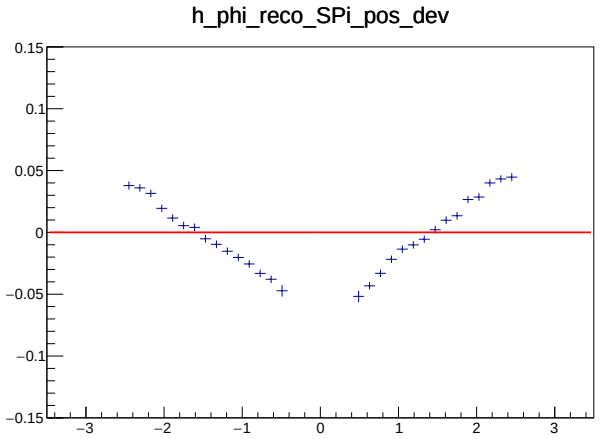


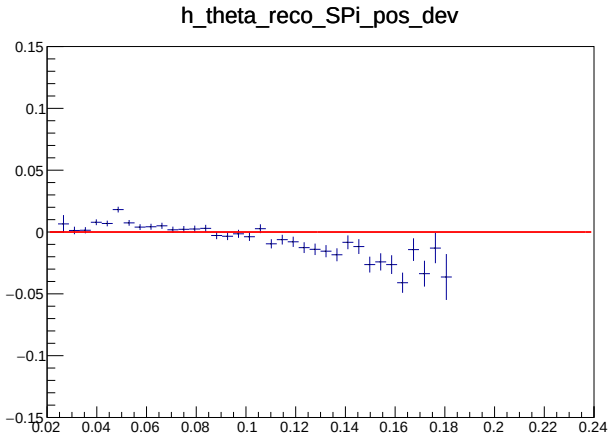


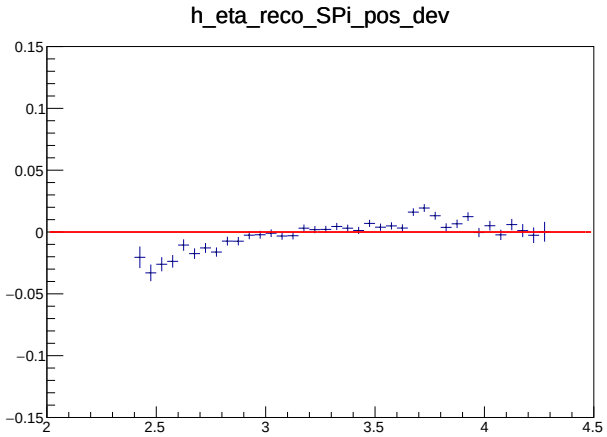


soft π deviation dependencies - *DOWN* polarity

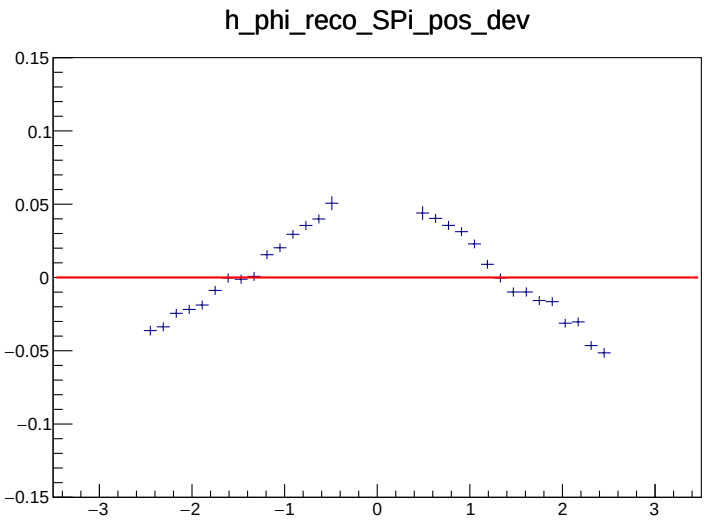


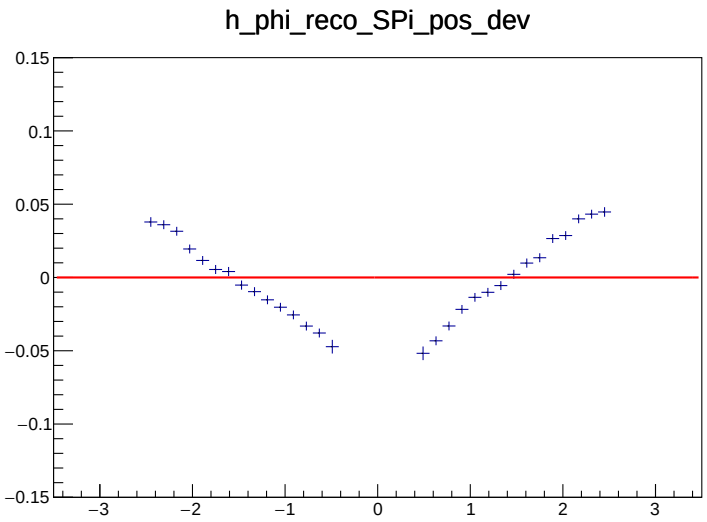




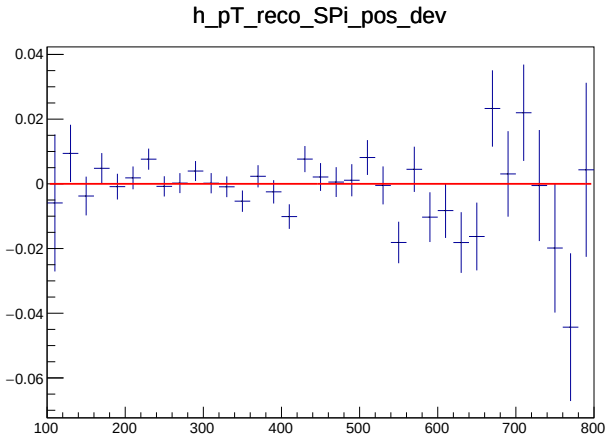


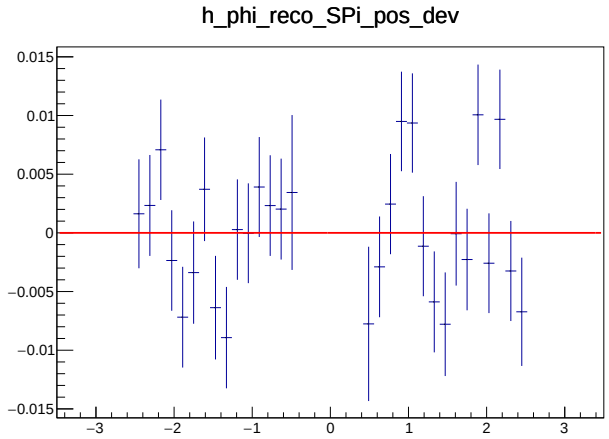
soft π deviation - ϕ

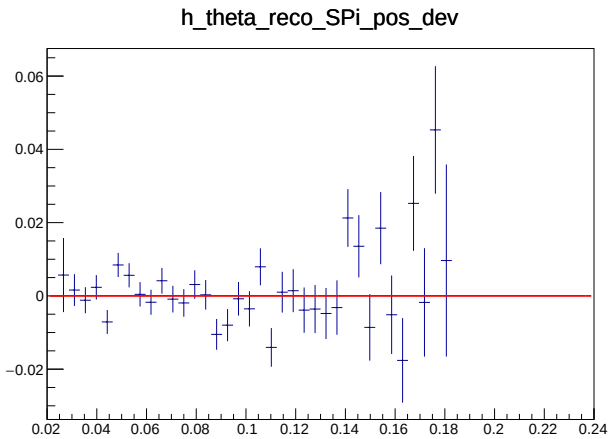


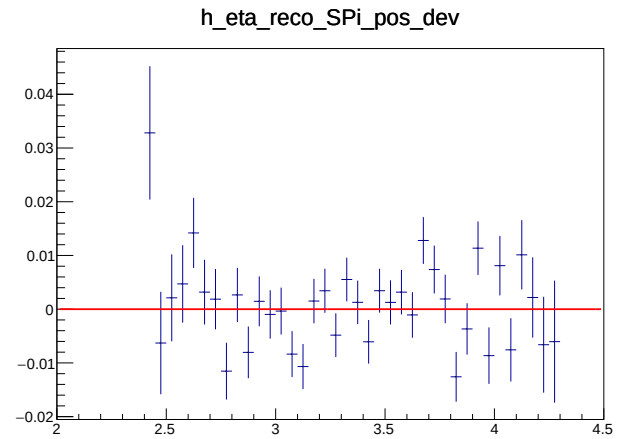


soft π deviation UP+DOWN



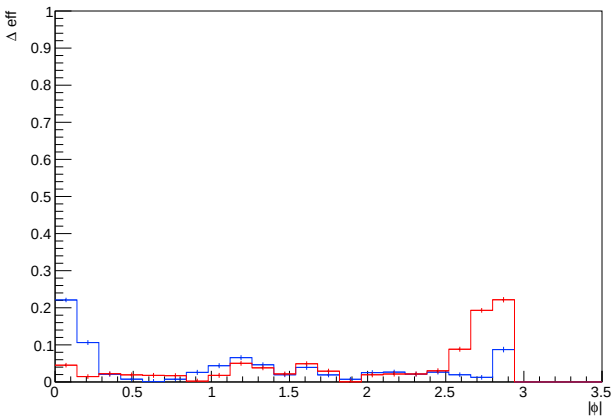


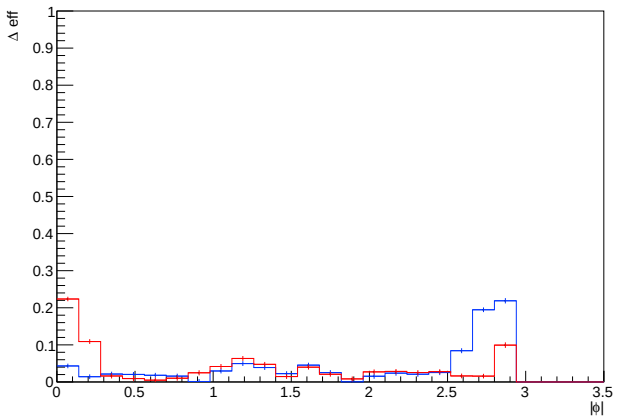




Idea 2

- $|\phi| < 0.3 \& |\phi| > 2.5$ & $\eta > 3$





Deviation before & after cut

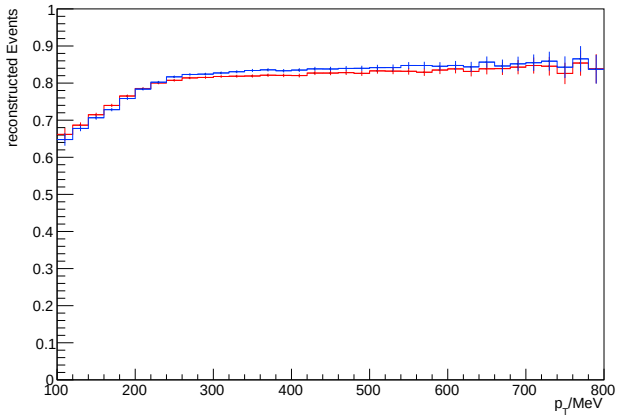
Table: The deviation $\frac{N_+ - N_-}{N_+ + N_-} / 10^{-3}$

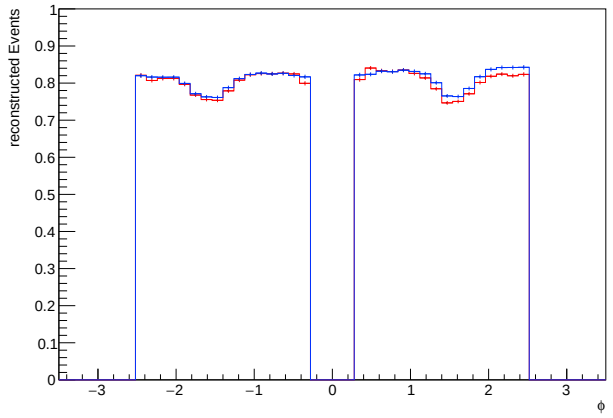
Polarity	π	K	$soft\pi$	D^0	D^*
UP	-0.1 ± 0.4	4.7 ± 0.4	-3.8 ± 0.5	-4.7 ± 0.5	-8.2 ± 0.5
DOWN	-0.3 ± 0.4	5.2 ± 0.4	3.7 ± 0.5	-5.0 ± 0.5	-0.8 ± 0.5

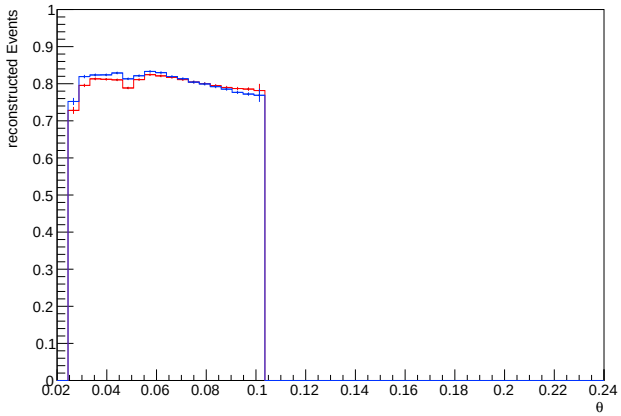
Polarity	π	K	$soft\pi$	D^0	D^*
UP	-0.1 ± 0.4	4.7 ± 0.4	-4.4 ± 0.6	-4.7 ± 0.5	-8.7 ± 0.7
DOWN	-0.3 ± 0.4	5.2 ± 0.4	4.1 ± 0.6	-5.0 ± 0.5	-0.2 ± 0.7

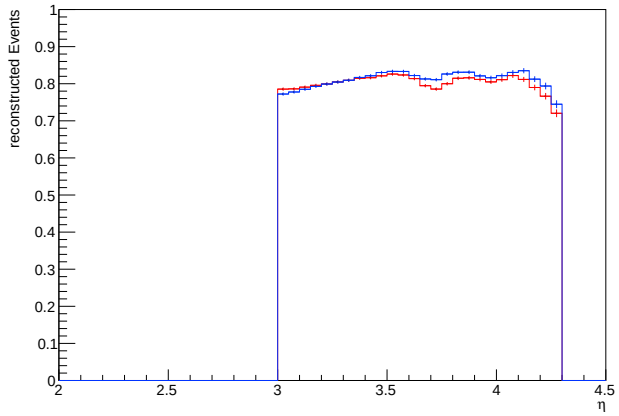
- deviation is even worse than before
- $\approx 50\%$ of events is rejected

Comparison of different charges with *UP* polarity - soft π

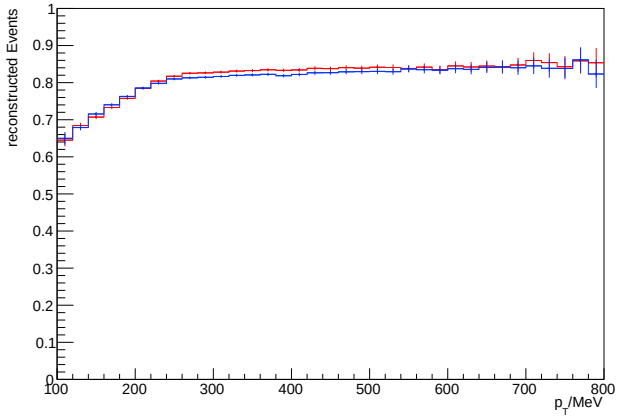


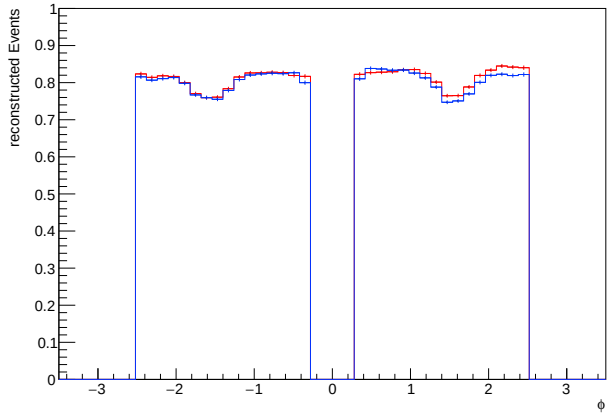


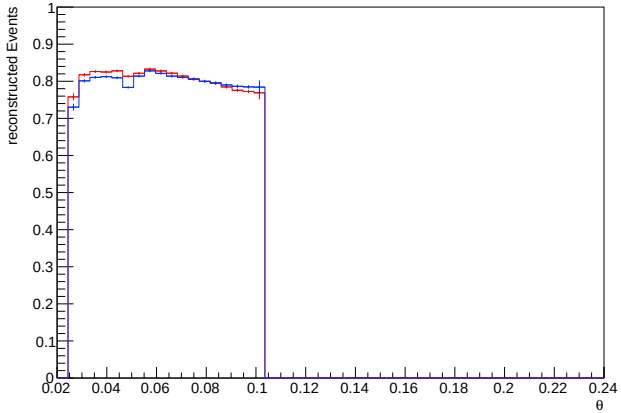


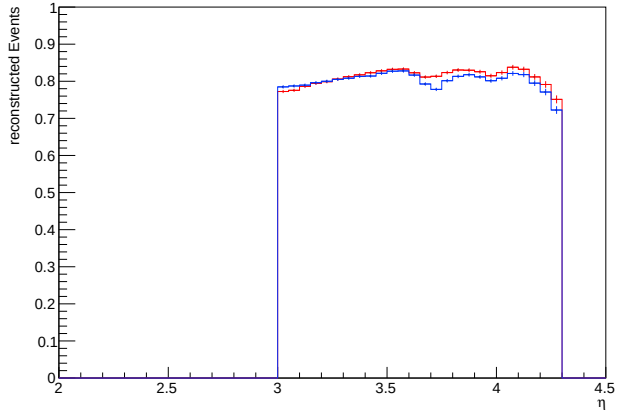


Comparison of different charges with *DOWN* polarity - soft π

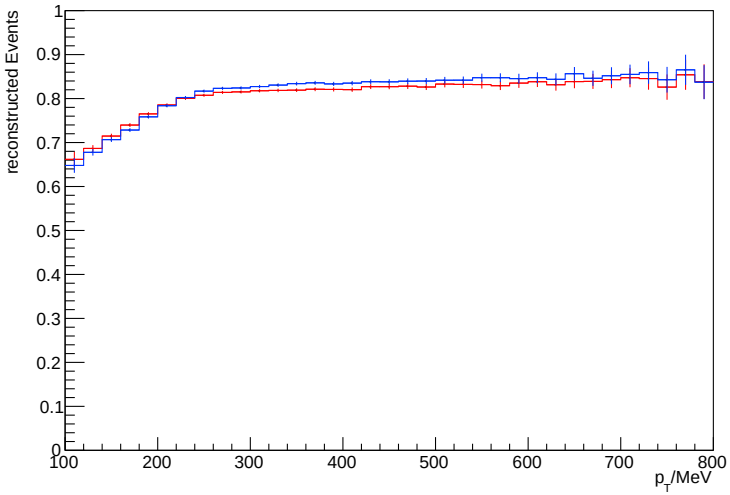


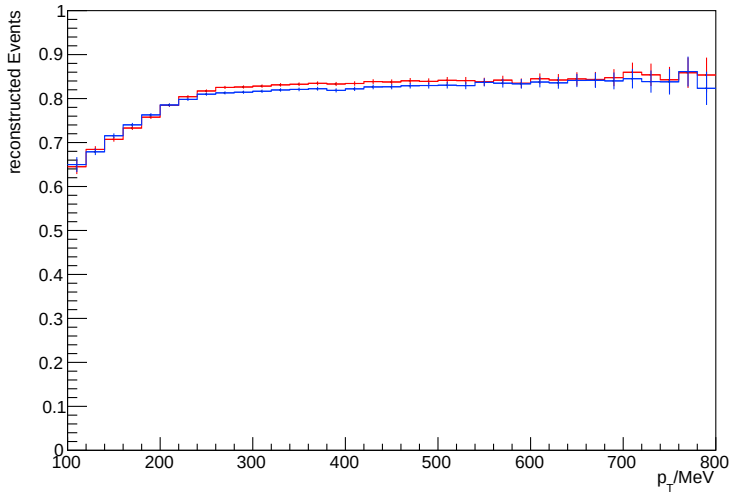




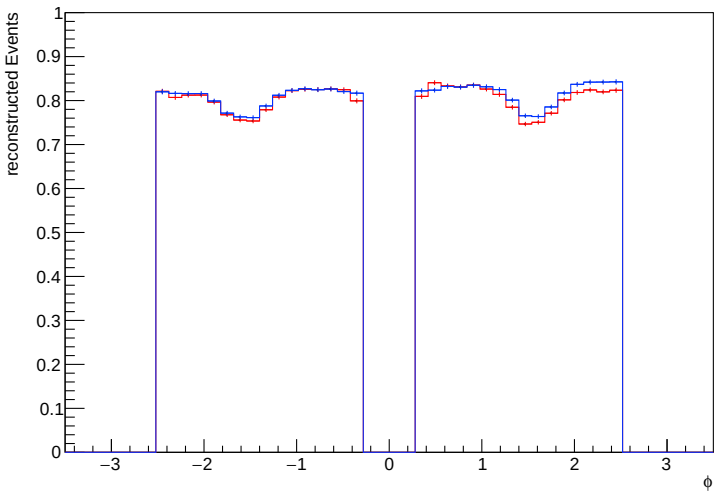


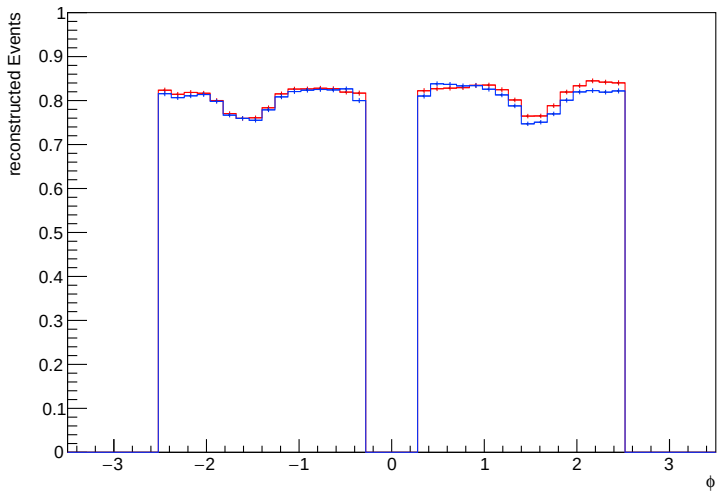
Comparison - soft πp_T



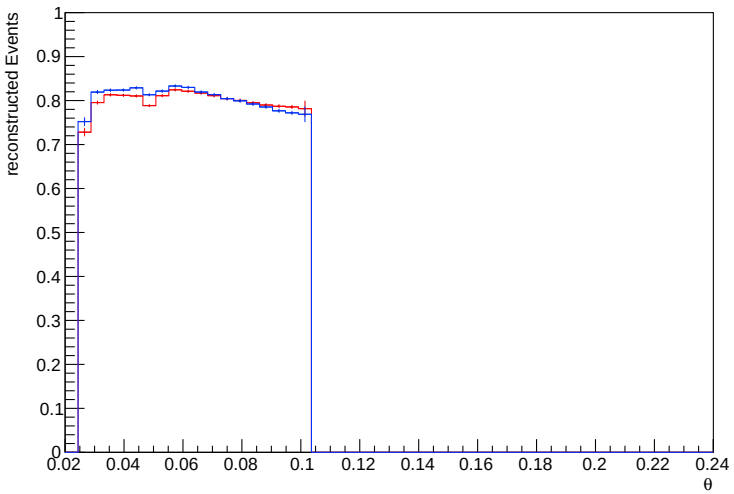


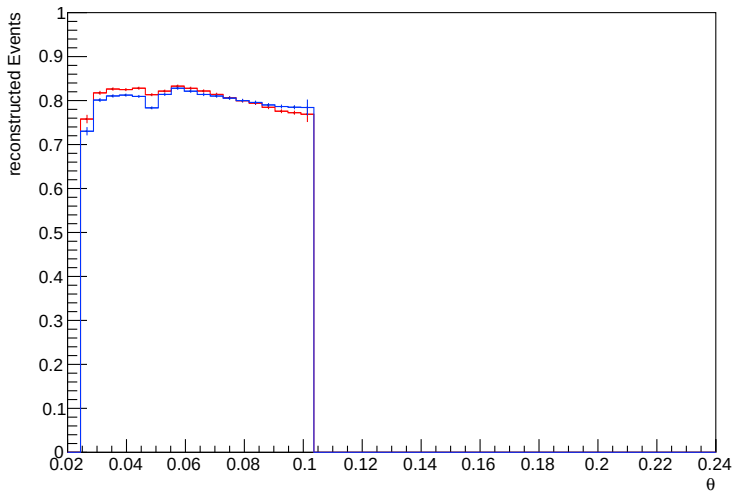
Comparison - soft $\pi\phi$



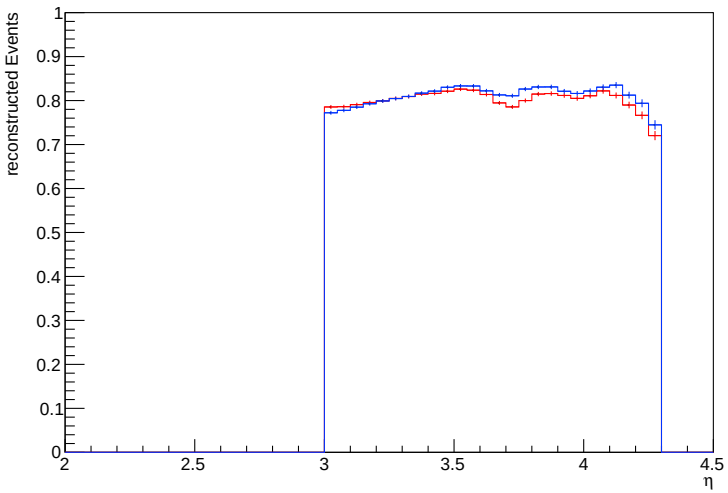


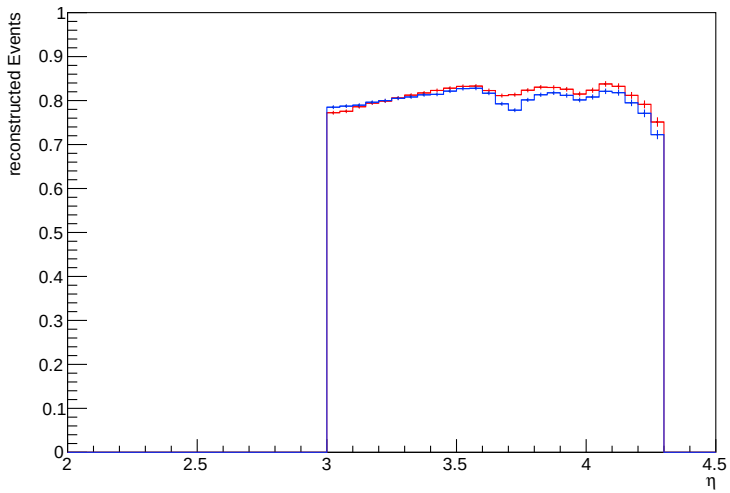
Comparison - soft $\pi\theta$



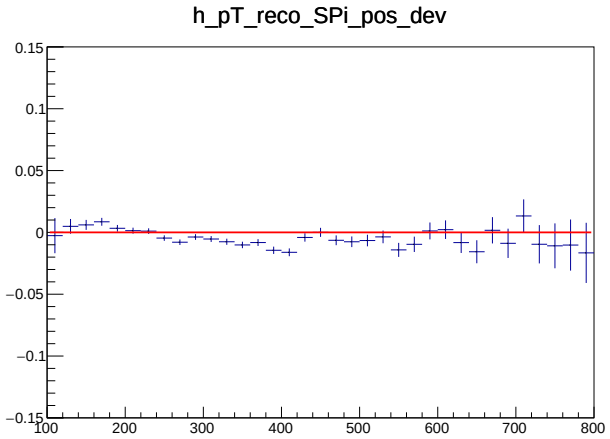


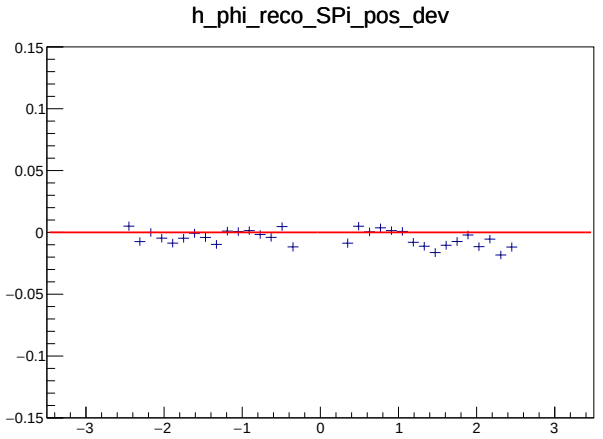
Comparison - soft $\pi\eta$

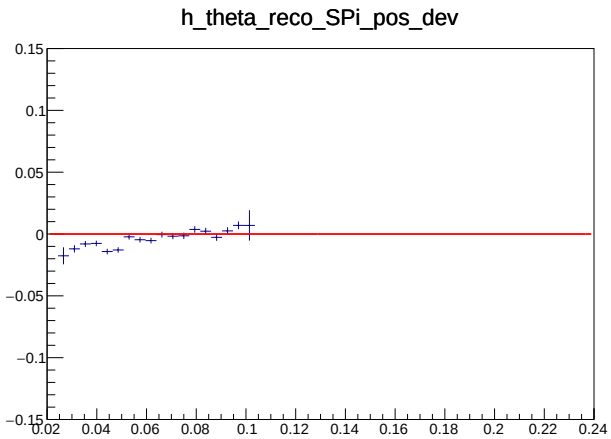


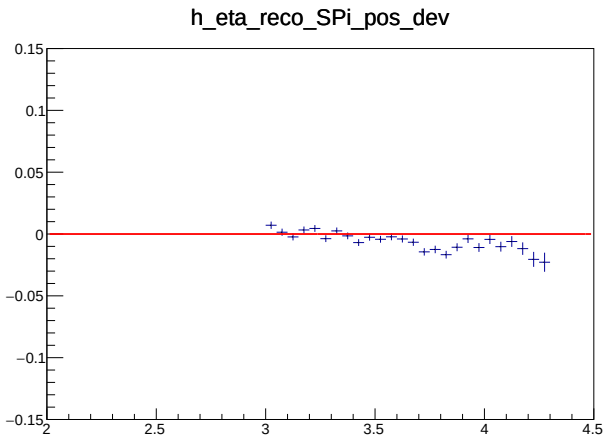


soft π deviation dependencies - *UP* polarity

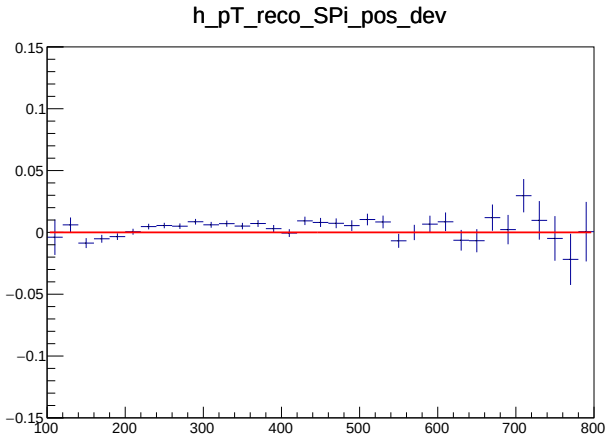


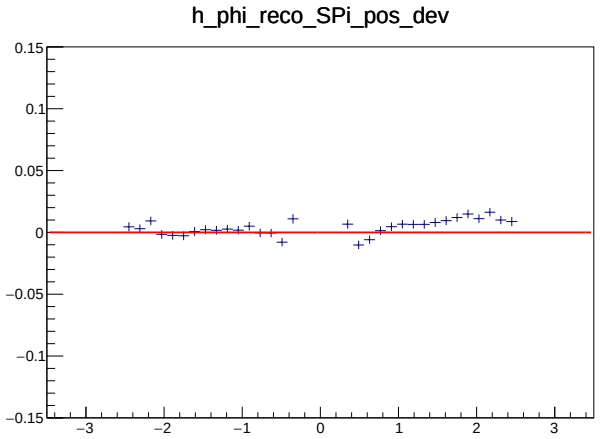


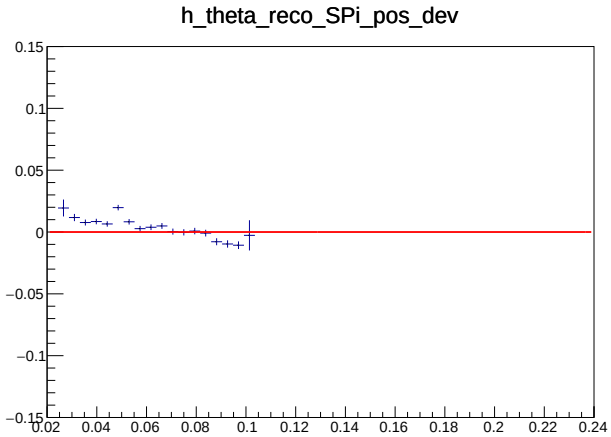


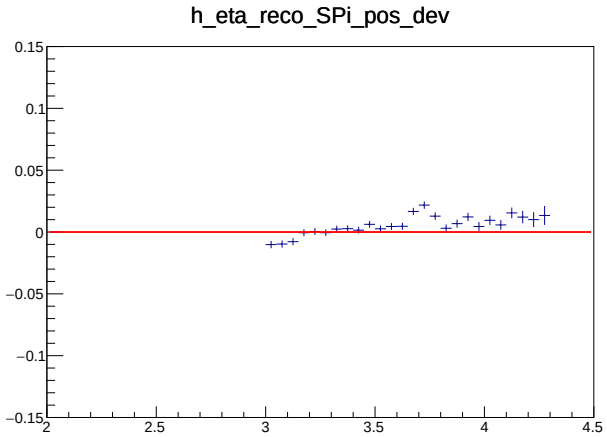


soft π deviation dependencies - *DOWN* polarity

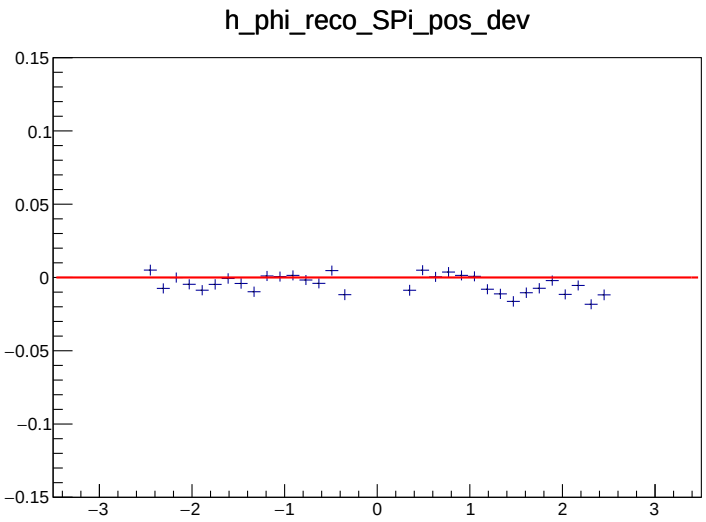


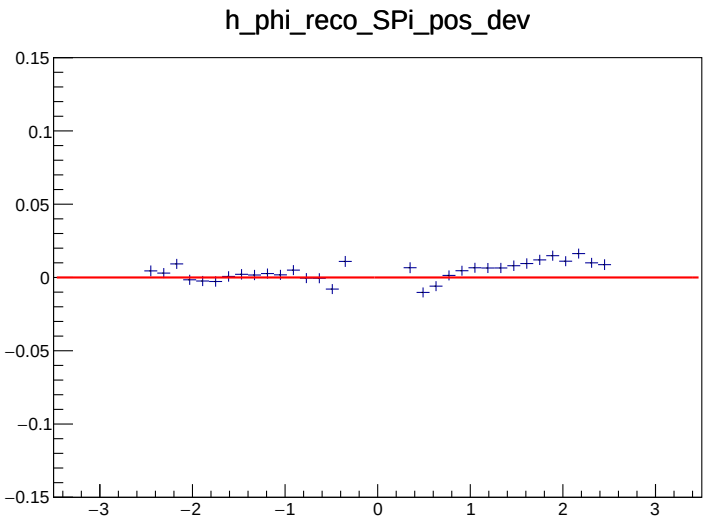




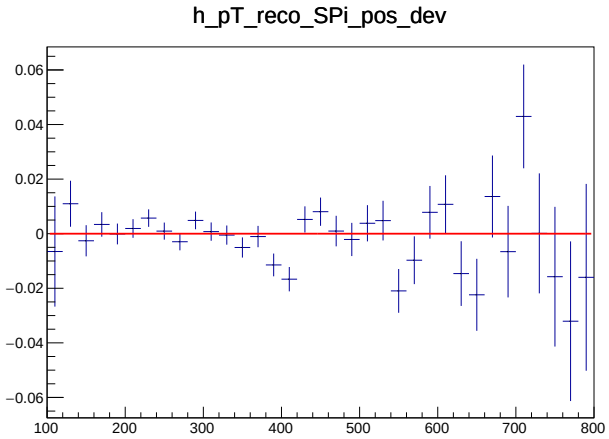


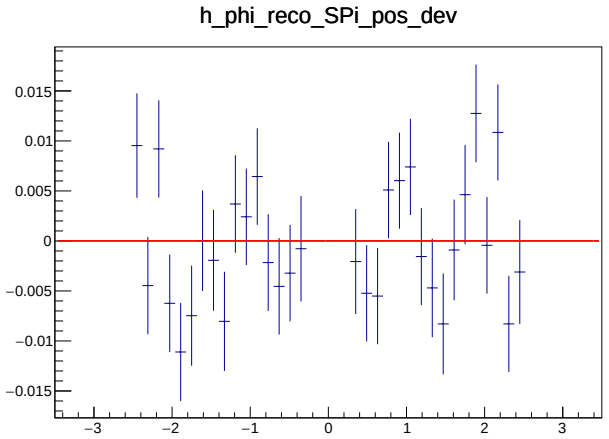
soft π deviation - ϕ

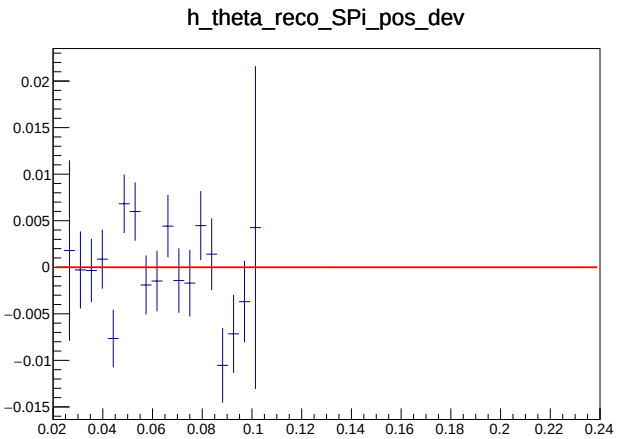


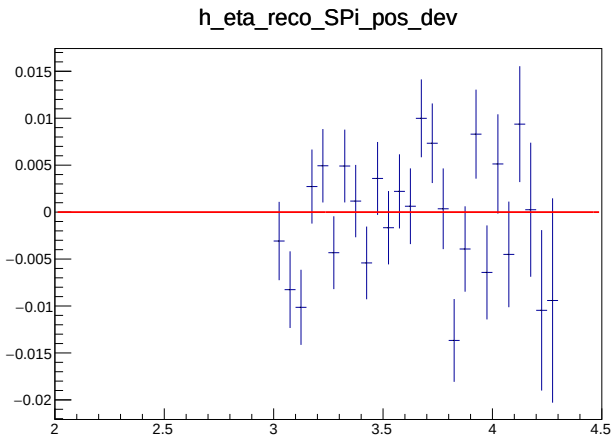


soft π deviation UP+DOWN



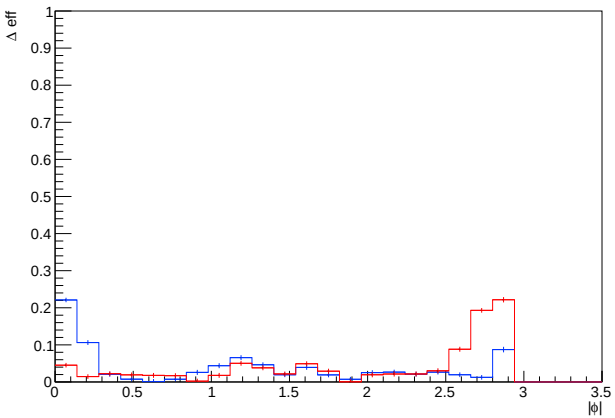


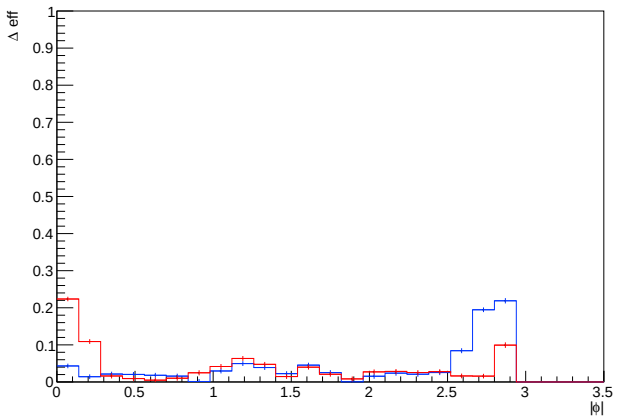




Idea 3

- $|\phi| < 0.3 \& |\phi| > 2.5$ & $\theta < 0.13$





Deviation before & after cut

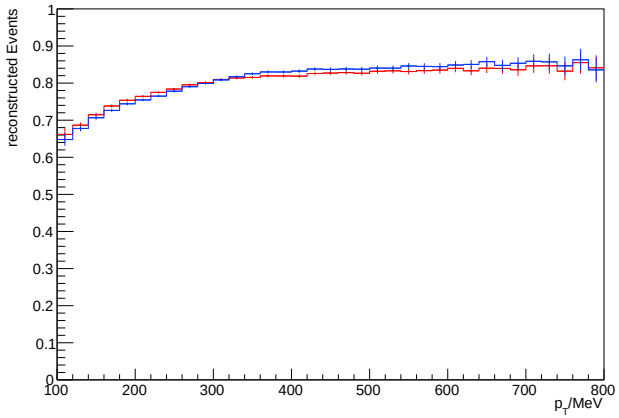
Table: The deviation $\frac{N_+ - N_-}{N_+ + N_-} / 10^{-3}$

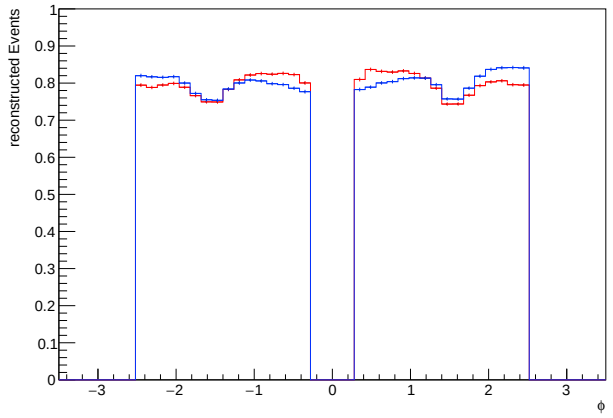
Polarity	π	K	$soft\pi$	D^0	D^*
UP	-0.1 ± 0.4	4.7 ± 0.4	-3.8 ± 0.5	-4.7 ± 0.5	-8.2 ± 0.5
DOWN	-0.3 ± 0.4	5.2 ± 0.4	3.7 ± 0.5	-5.0 ± 0.5	-0.8 ± 0.5

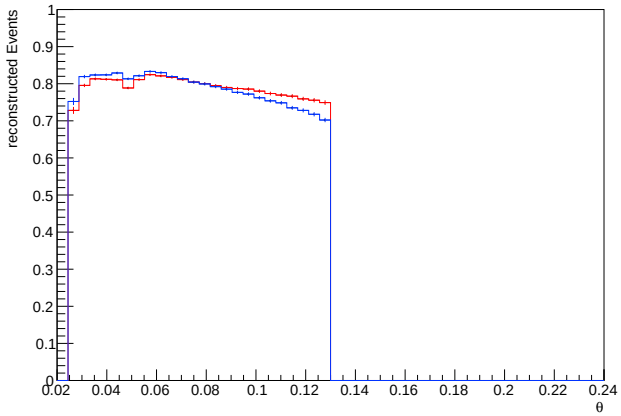
Polarity	π	K	$soft\pi$	D^0	D^*
UP	-0.1 ± 0.4	4.7 ± 0.4	-1.0 ± 0.6	-4.7 ± 0.5	-5.2 ± 0.6
DOWN	-0.3 ± 0.4	5.2 ± 0.4	0.3 ± 0.6	-5.0 ± 0.5	-4.0 ± 0.6

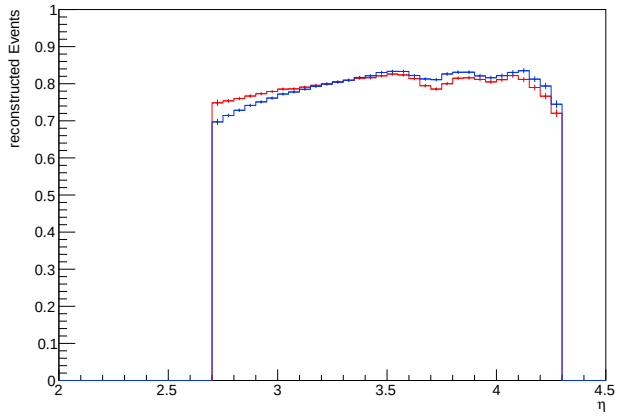
- change in sign of $D_s \pi$
- $\approx 33\%$ of events is rejected

Comparison of different charges with *UP* polarity - soft π

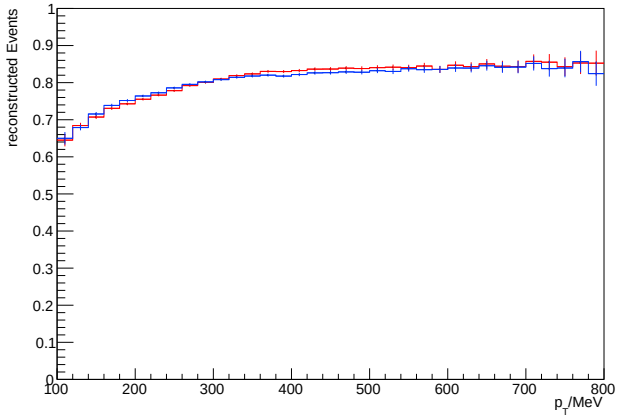


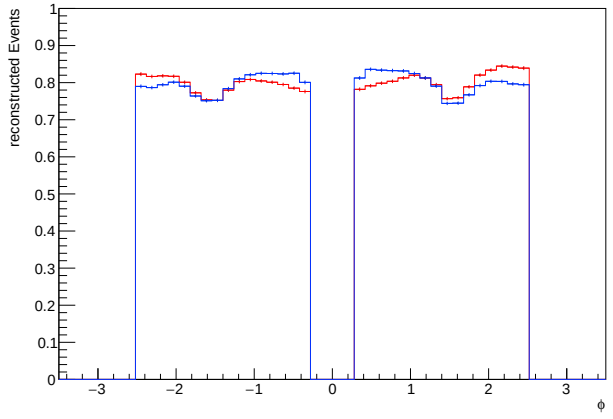


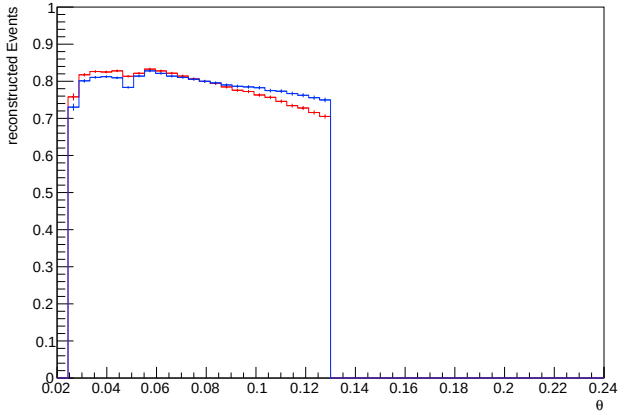


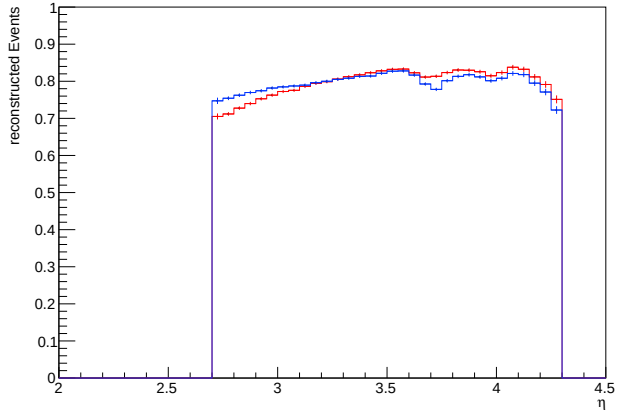


Comparison of different charges with *DOWN* polarity - soft π

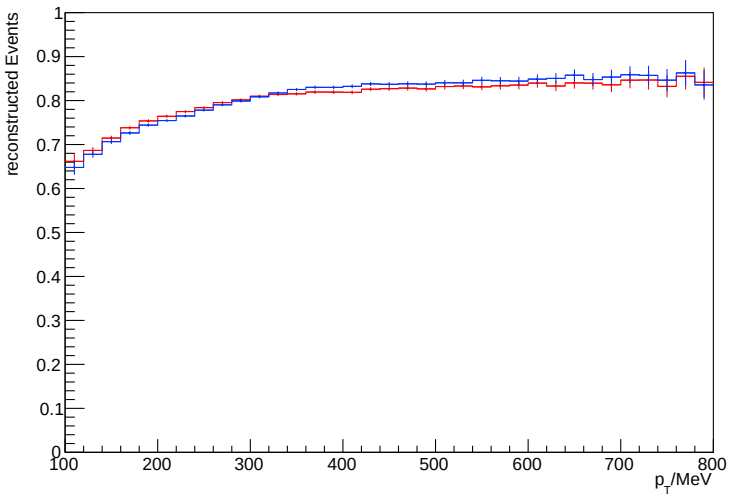


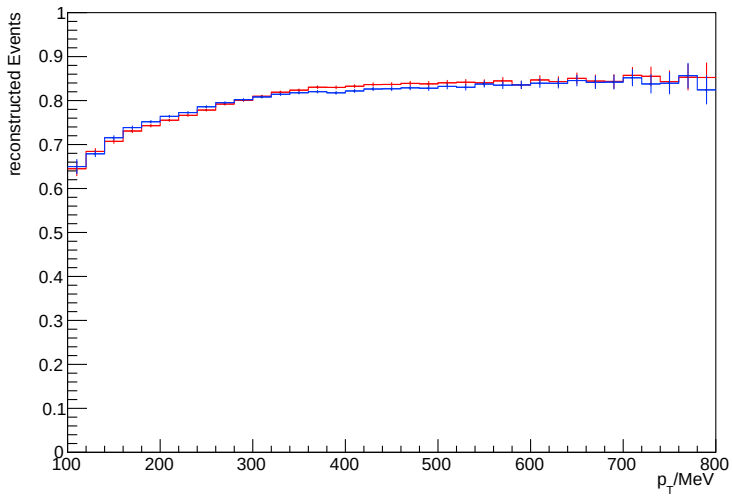




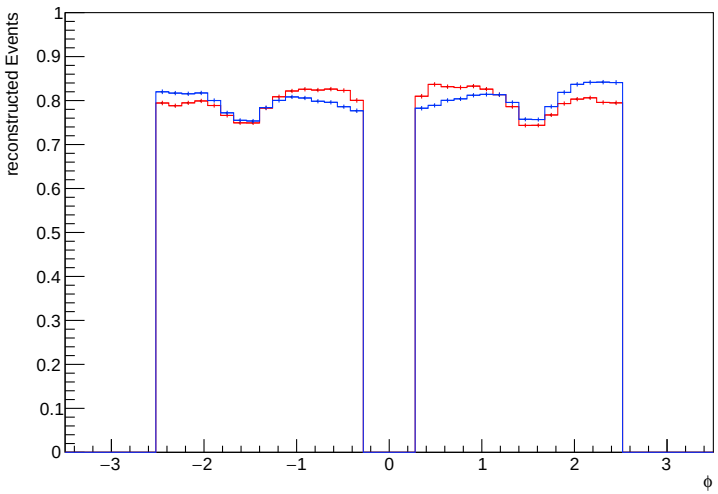


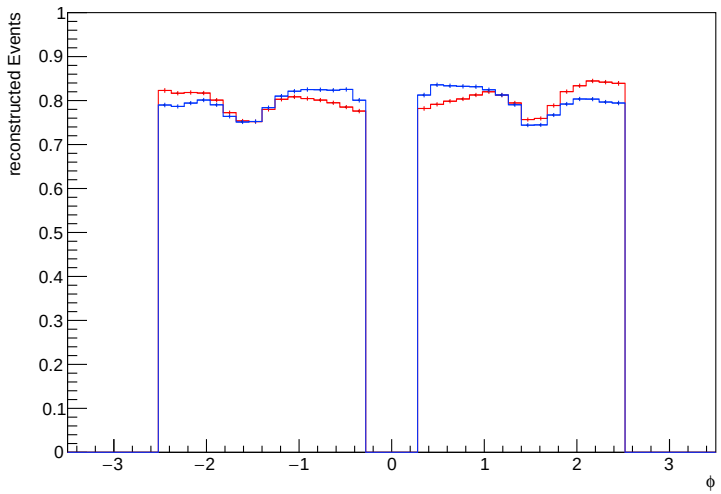
Comparison - soft πp_T



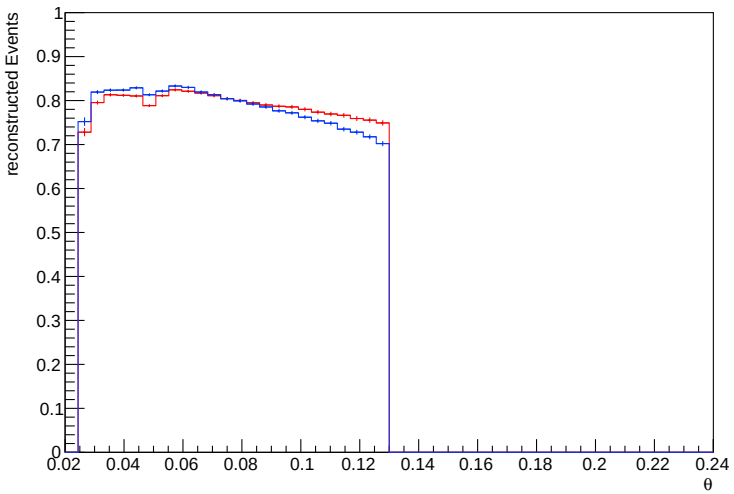


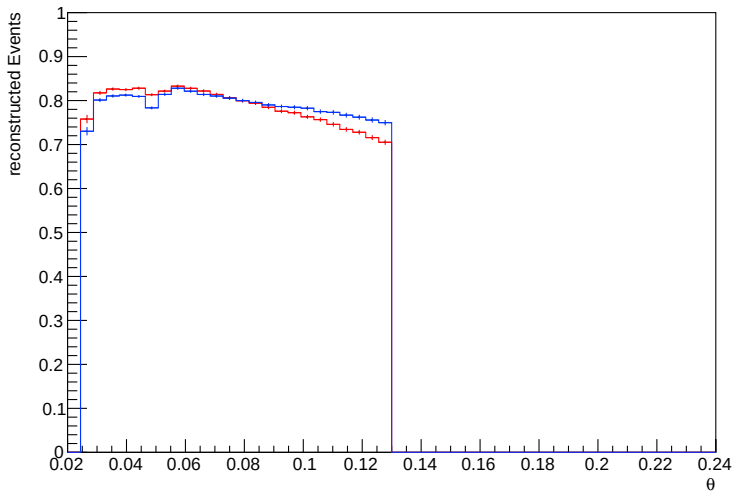
Comparison - soft $\pi\phi$



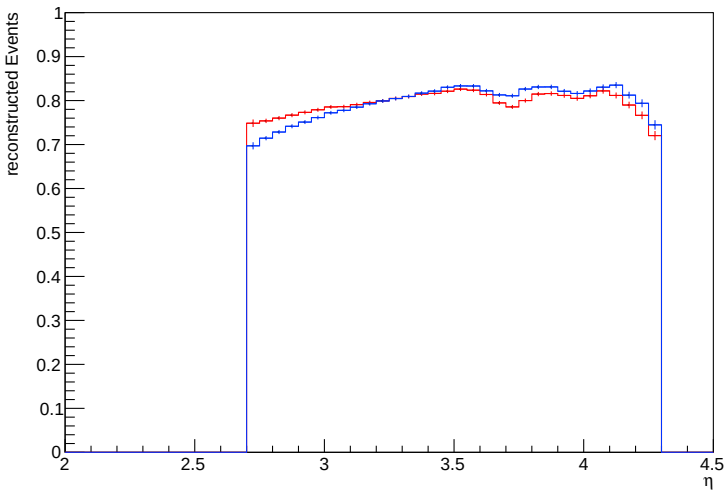


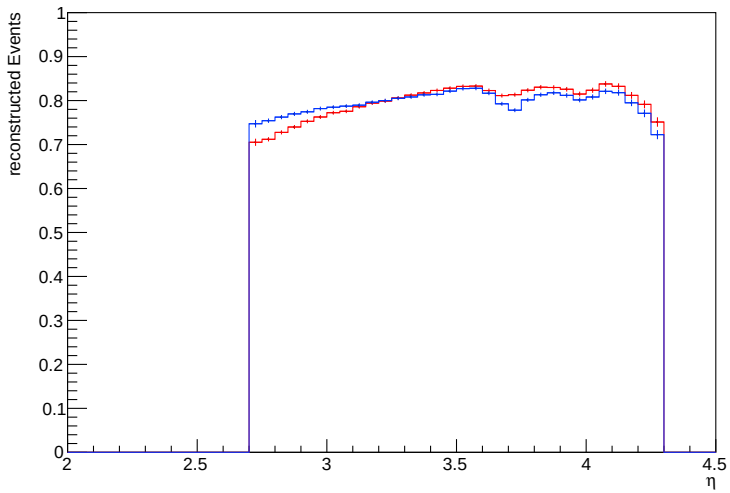
Comparison - soft $\pi\theta$



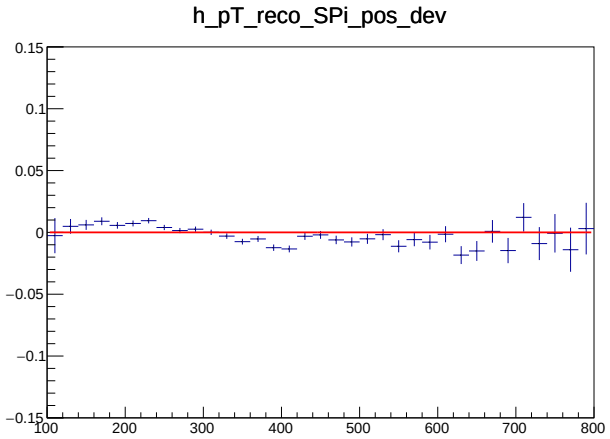


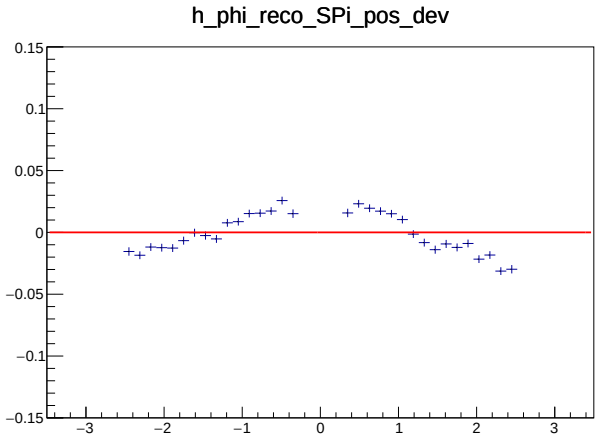
Comparison - soft $\pi\eta$

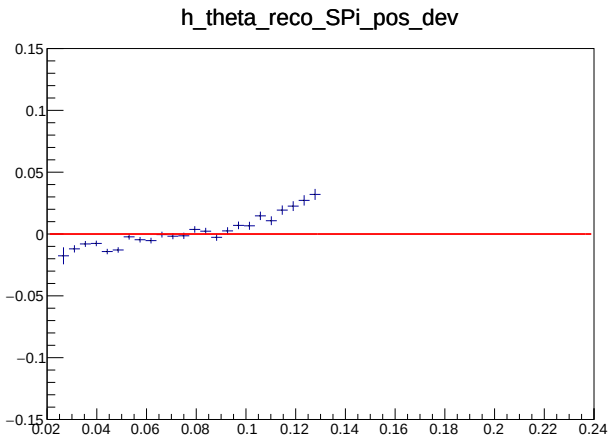


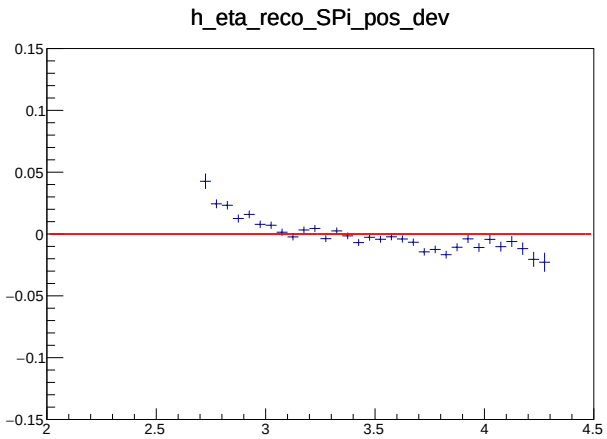


soft π deviation dependencies - *UP* polarity

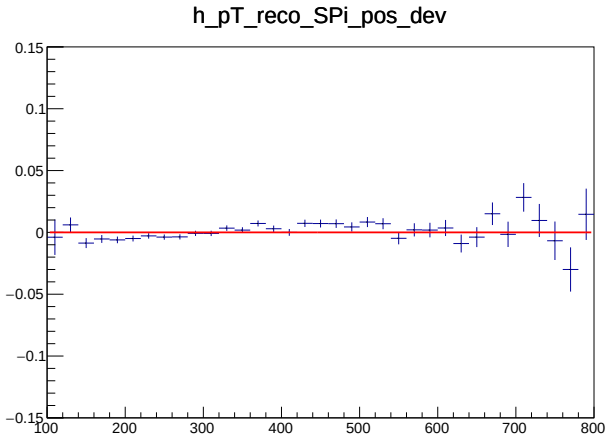


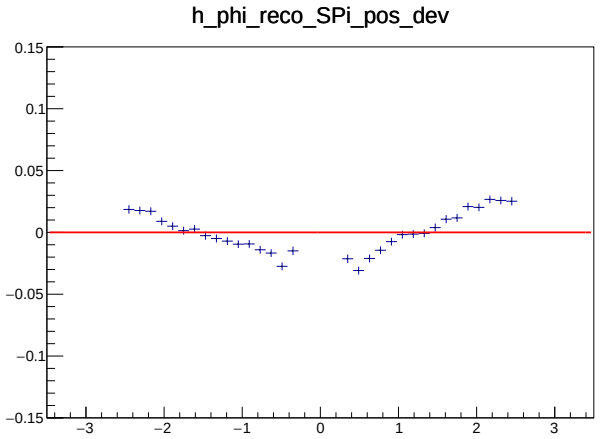


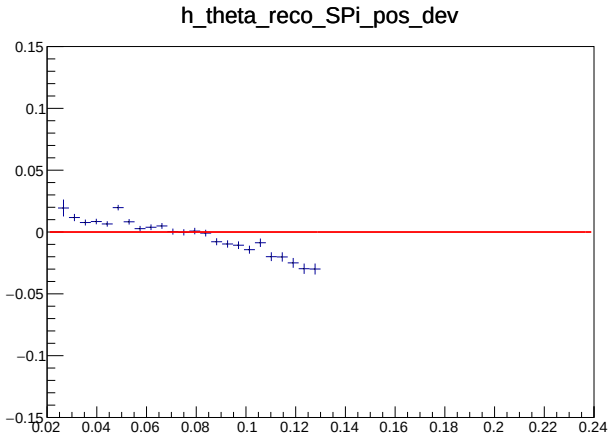


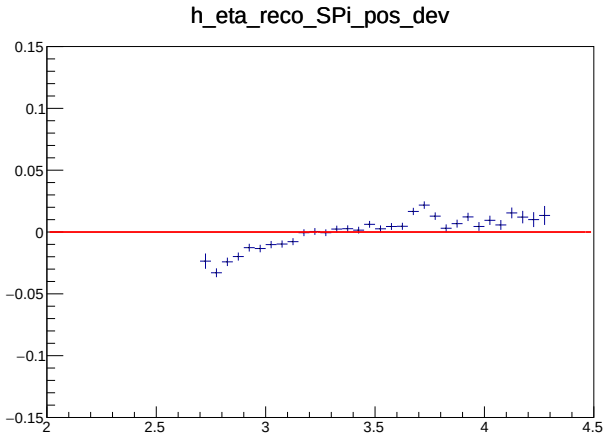


soft π deviation dependencies - *DOWN* polarity

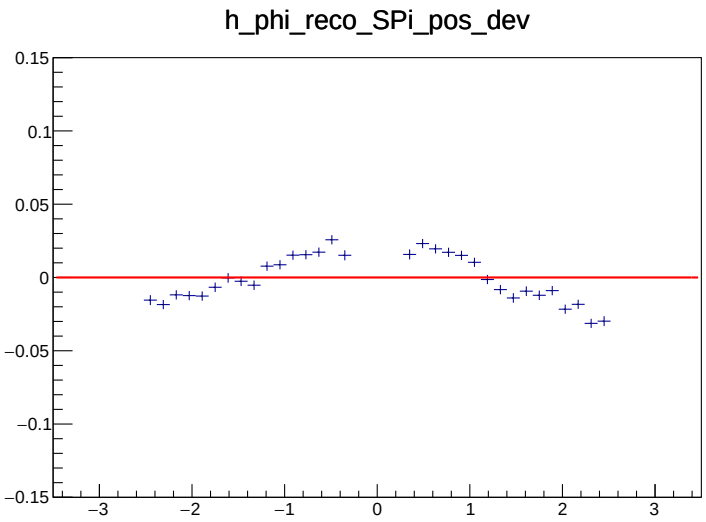


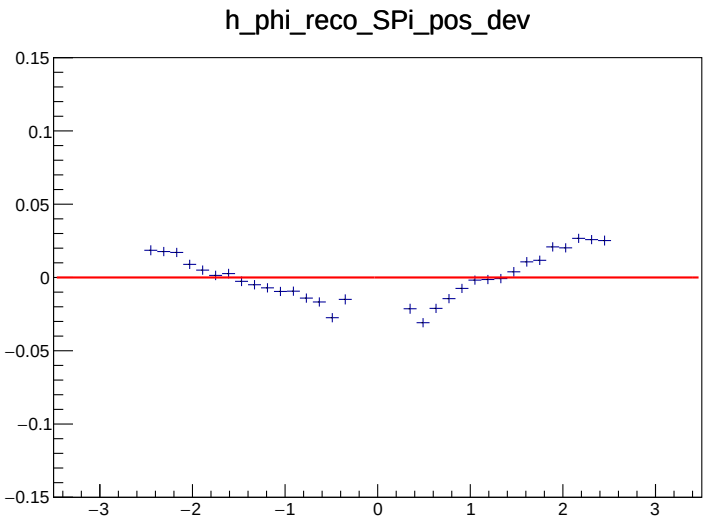






soft π deviation - ϕ





soft π deviation UP+DOWN