

Instrumental asymmetries

$$D^+ \rightarrow K_S^0 \pi^+$$

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Analysis meeting
June 17, 2022

Overview

Target sample	Target Adet	Initial Adet	Corrected Adet	Initial difference	Final difference
$B^+ \rightarrow \rho^+ \rho^0$	0.0011 ± 0.0014	0.0058 ± 0.0016	0.0053 ± 0.0014	2.21σ	1.98σ
$B^+ \rightarrow \bar{D}^0 \pi^+$	0.0054 ± 0.0011	0.0053 ± 0.0016	0.0064 ± 0.0016	0.05σ	0.52σ
$B^+ \rightarrow \pi^+ \pi^0$	-0.0002 ± 0.0013	0.0053 ± 0.0016	0.0137 ± 0.0016	2.67σ	$> 6\sigma$
$B^+ \rightarrow \pi^+ \pi^0$	-0.0002 ± 0.0013	0.0080 ± 0.0027	0.0236 ± 0.0016	2.74σ	$> 6\sigma$

Last one with CS>0.5 and pionID>0.5 cuts in control sample

$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC

- Consider $B^+ \rightarrow \pi^+ \pi^0$ decays

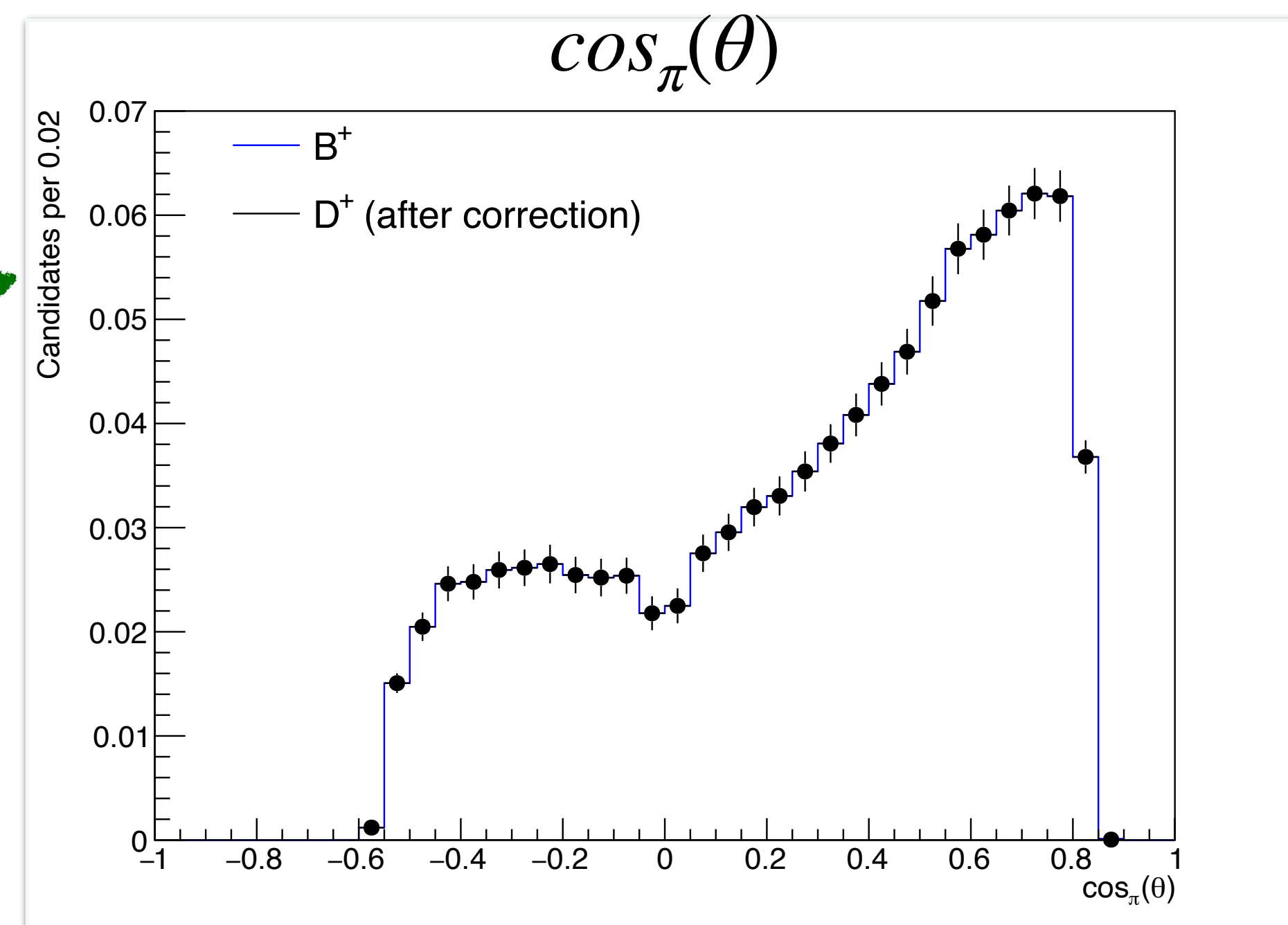
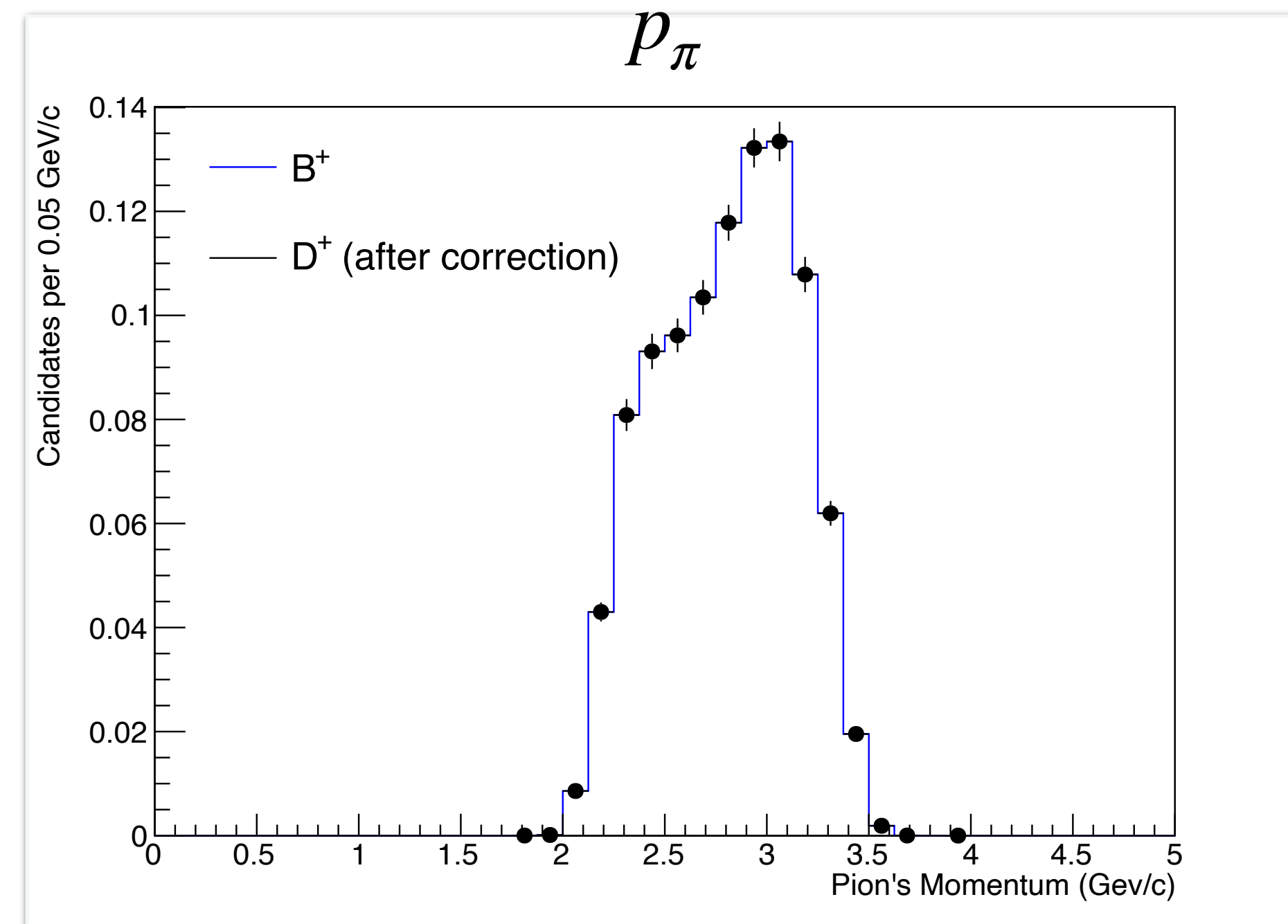
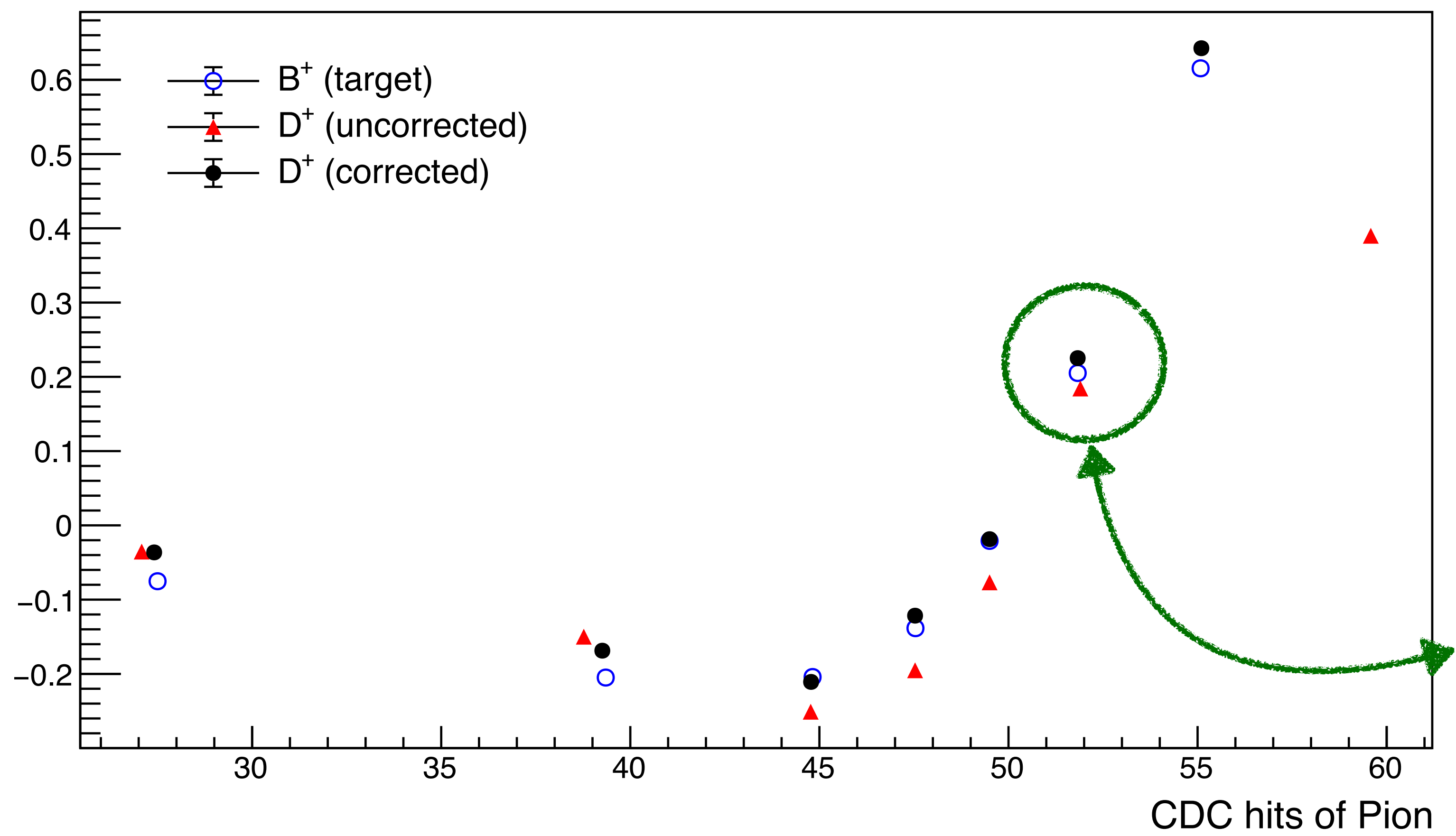
$$\mathcal{A}_{\text{det}}(\pi) = -0.0002 \pm 0.0013 \text{ (target).}$$

~2.67 σ away

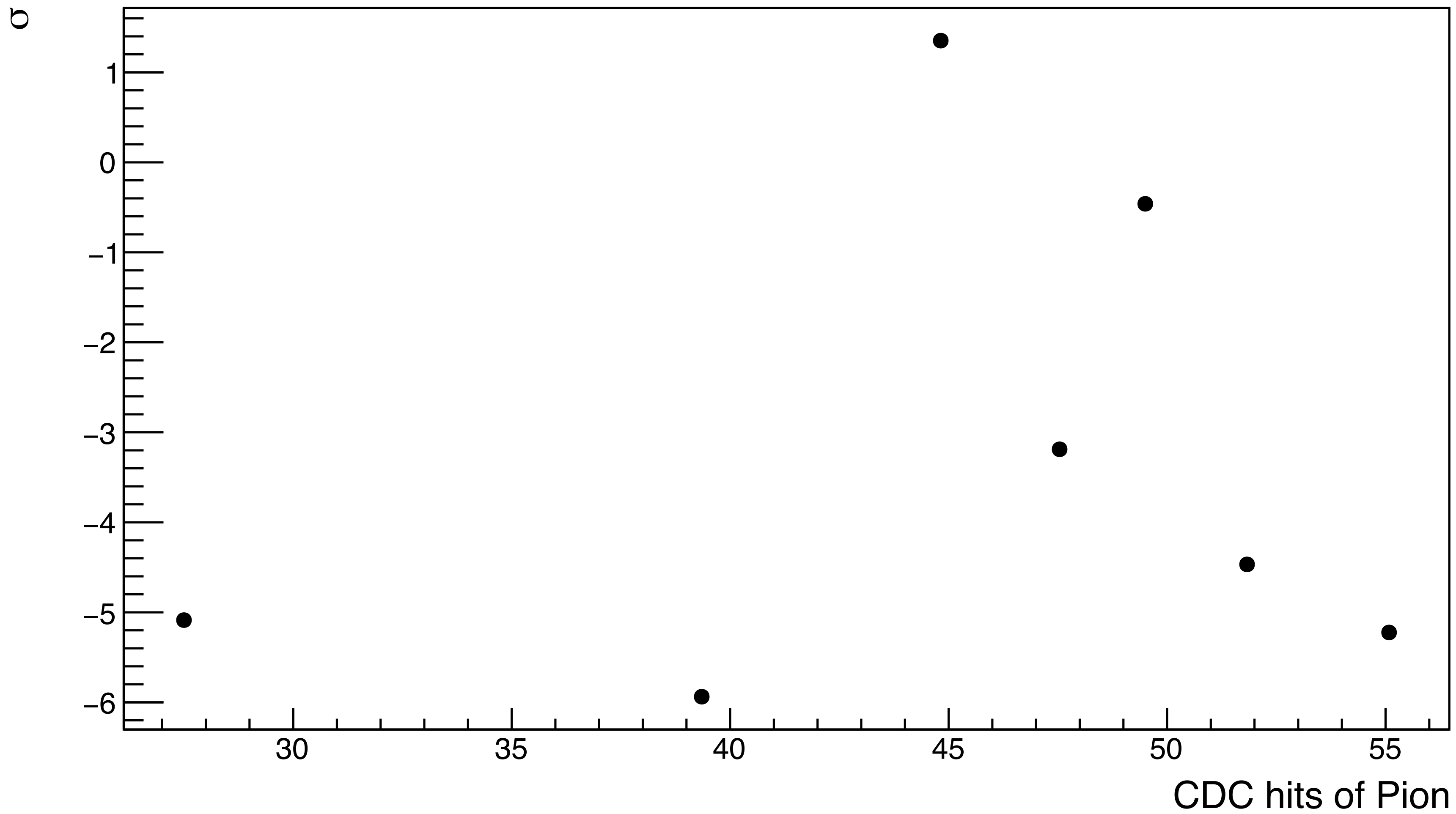
- $D^+ \rightarrow K_S^0 \pi^+$ control channel (no cut on pid and CS)

$$\mathcal{A}_{\text{det}}(\pi) = 0.0053 \pm 0.0016 \text{ (start value).}$$

$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC



$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC



$$\sigma = \frac{\text{target} - \text{corrected}}{\sqrt{(\Delta\text{target})^2 + (\Delta\text{corrected})^2}}$$

$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC

No. of events in a bin of CDC hits of target sample

Total events

Bin of CDC hits	Fraction
20 < hits < 34	0.0456
34 <= hits < 43	0.0976
43 <= hits < 47	0.1916
47 <= hits < 49	0.1747
49 <= hits < 51	0.1992
51 <= hits < 54	0.2156
54 <= hits	0.0756

$$\mathcal{A}_{\text{det}}(\pi) = 0.0137 \pm 0.0016$$

(after correction with momentum and polar angle)

$$\mathcal{A}_{\text{det}}(\pi) = -0.0002 \pm 0.0013 \text{ (target)} \\ \text{(integrated)}$$

DISAGGREEMENT

$\mathcal{A}_{det}(\pi)$ closure-test with MC

No. of events in a bin of CDC hits of target sample

Total events

Bin of CDC hits	Fraction
20 < hits < 34	0.0456
34 <= hits < 43	0.0976
43 <= hits < 47	0.1916
47 <= hits < 49	0.1747
49 <= hits < 51	0.1992
51 <= hits < 54	0.2156
54 <= hits	0.0756

Calculated by $\mathcal{A}_{det} = \sum \mathcal{A}_{bin} \times f_{bin}$

$\mathcal{A}_{det}(\pi) = 0.0040 \pm 0.0016$ (start value)

$\mathcal{A}_{det}(\pi) = 0.0137 \pm 0.0016$

(after correction with momentum and polar angle)

$\mathcal{A}_{det}(\pi) = -0.0002 \pm 0.0012$ (target)

DISAGGREGMENT

$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC

- Consider $B^+ \rightarrow \pi^+ \pi^0$ decays

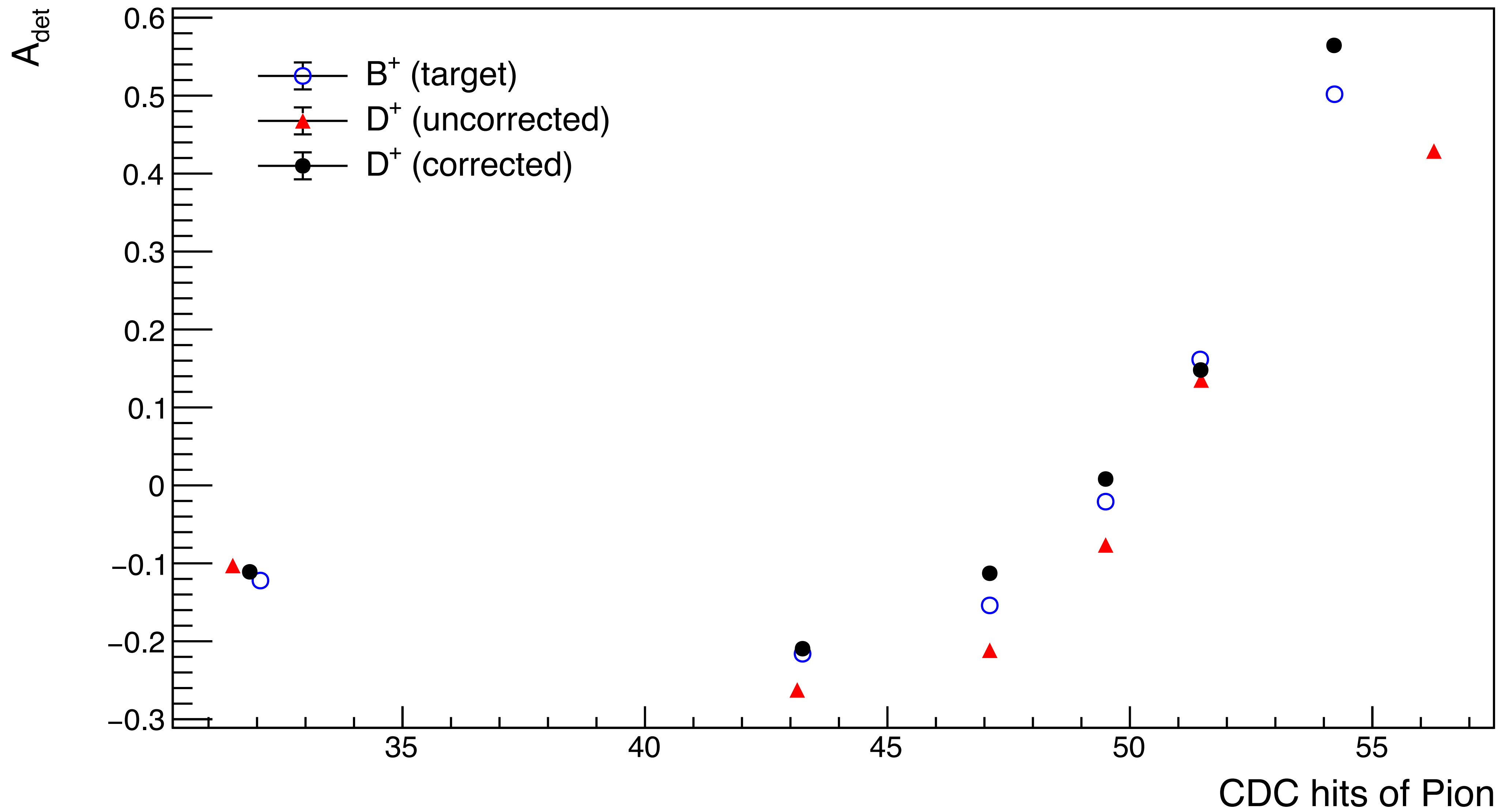
$$\mathcal{A}_{\text{det}}(\pi) = -0.0002 \pm 0.0013 \text{ (target).}$$

$\sim 2.7 \sigma$ away

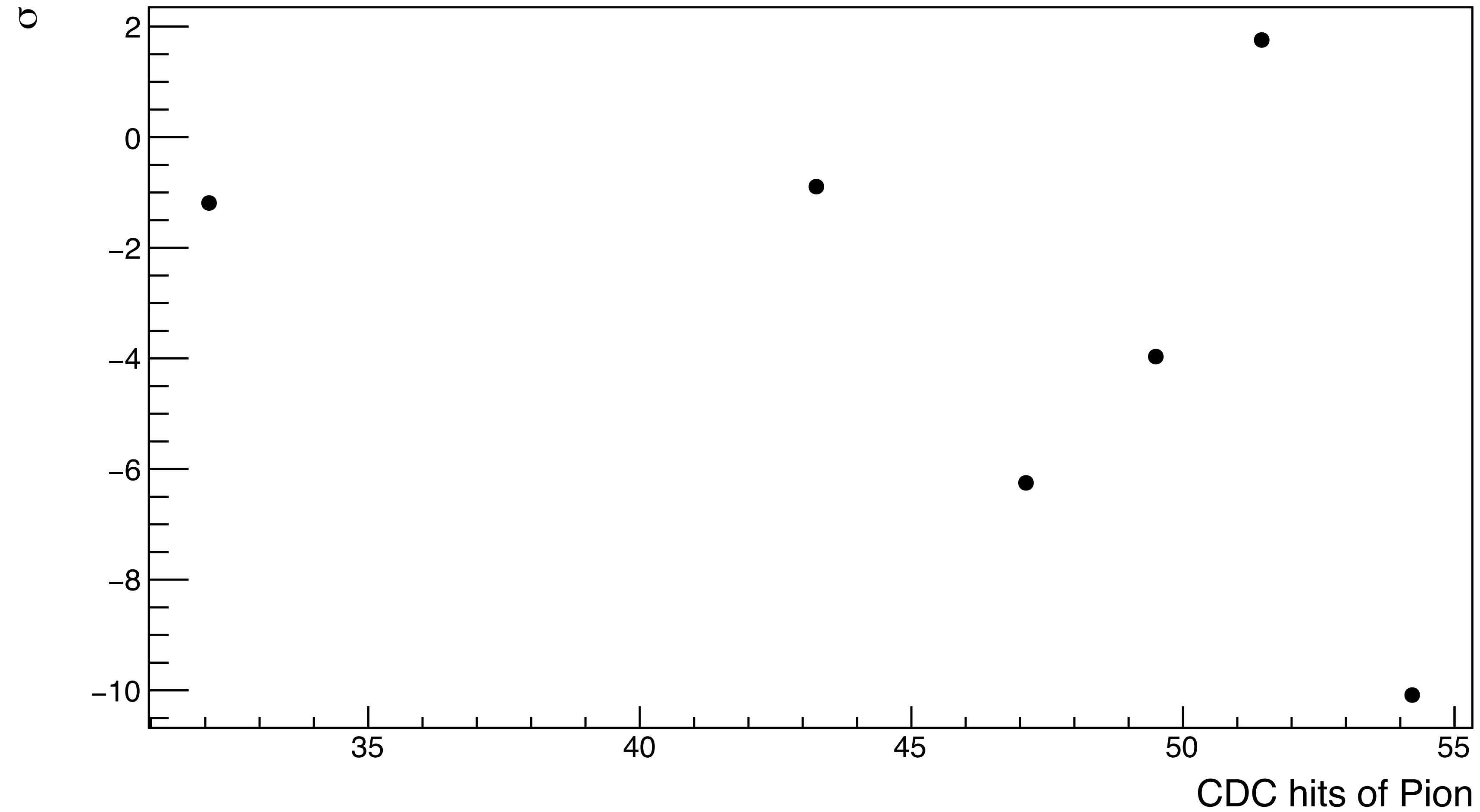
- $D^+ \rightarrow K_S^0 \pi^+$ control channel (pionID>0.5 and CS>0.5)

$$\mathcal{A}_{\text{det}}(\pi) = 0.0080 \pm 0.0027 \text{ (start value).}$$

$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC



$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC



$$\sigma = \frac{\text{target} - \text{corrected}}{\sqrt{(\Delta\text{target})^2 + (\Delta\text{corrected})^2}}$$

$\mathcal{A}_{\text{det}}(\pi)$ closure-test with MC

No. of events in a bin of CDC hits of target sample

Total events

Bin of CDC hits	Fraction
20 < hits < 40	0.0882
40 <= hits < 46	0.1791
46 <= hits < 49	0.2423
49 <= hits < 51	0.1992
51 <= hits < 53	0.1627
53 <= hits	0.1285

$$\mathcal{A}_{\text{det}}(\pi) = 0.0236 \pm 0.0027$$

(after correction with momentum and polar angle)

$$\mathcal{A}_{\text{det}}(\pi) = -0.0002 \pm 0.0013 \text{ (target)} \\ \text{(integrated)}$$

DISAGGREEMENT

$\mathcal{A}_{det}(\pi)$ closure-test with MC

No. of events in a bin of CDC hits of target sample

Total events

Bin of CDC hits	Fraction
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51 <= hits < 53	0.1627
53 <= hits	0.1285

Calculated by $\mathcal{A}_{det} = \sum \mathcal{A}_{bin} \times f_{bin}$

$$\mathcal{A}_{det}(\pi) = 0.0073 \pm 0.0027 \text{ (start value)}$$

$$\mathcal{A}_{det}(\pi) = 0.0236 \pm 0.0027$$

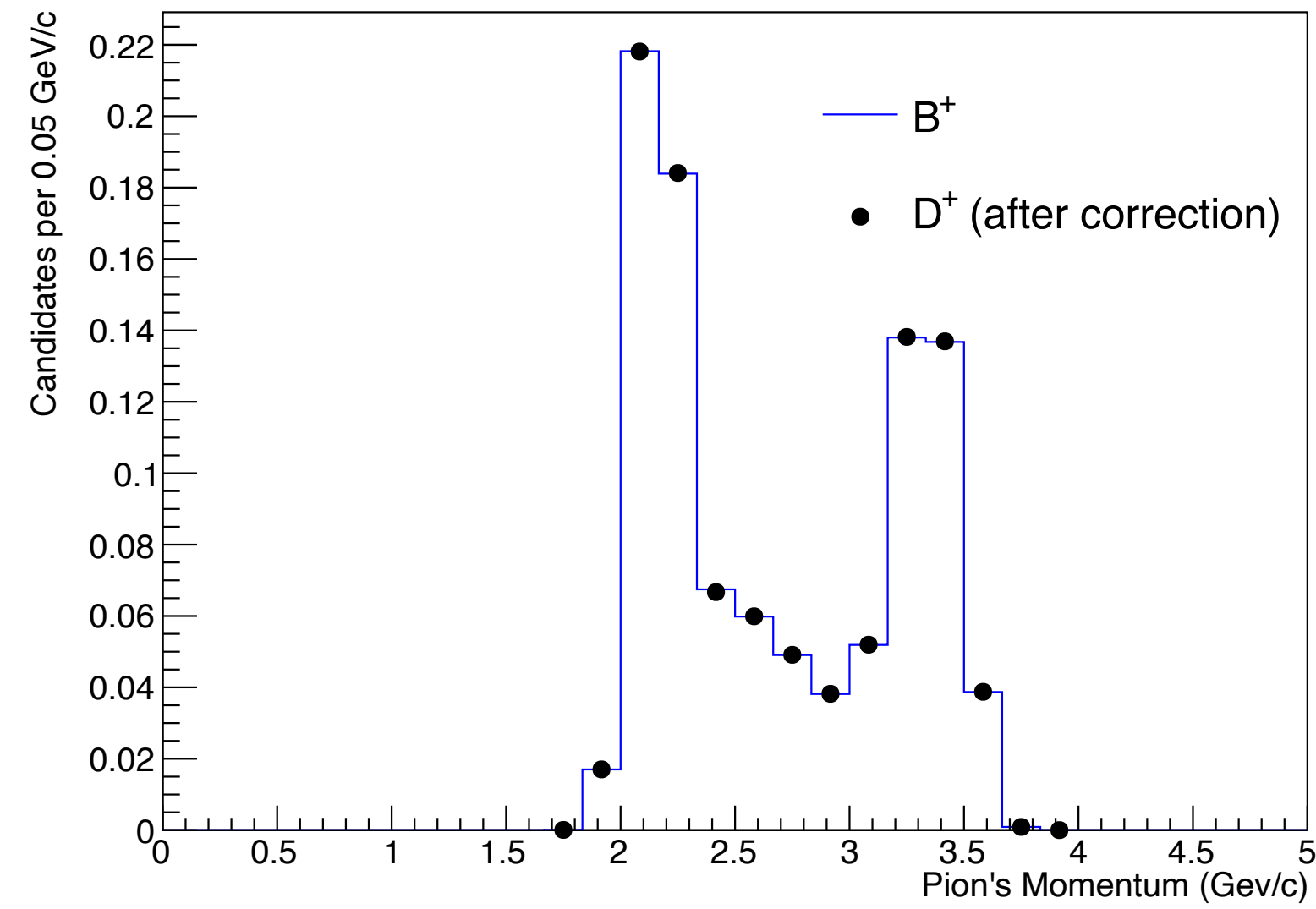
(after correction with momentum and polar angle)

$$\mathcal{A}_{det}(\pi) = -0.0002 \pm 0.0012 \text{ (target)}$$

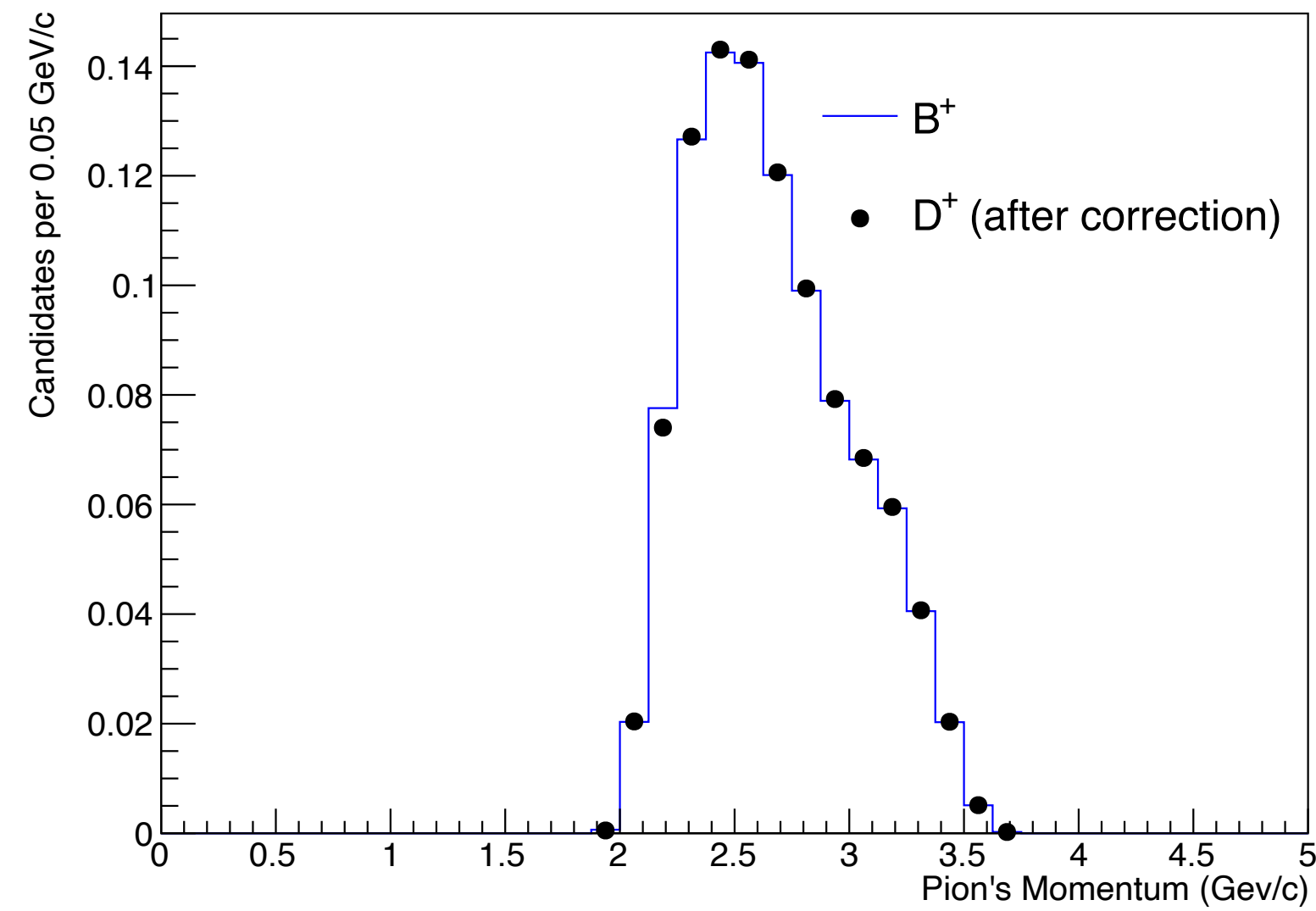
DISAGGREEMENT

p_π distribution

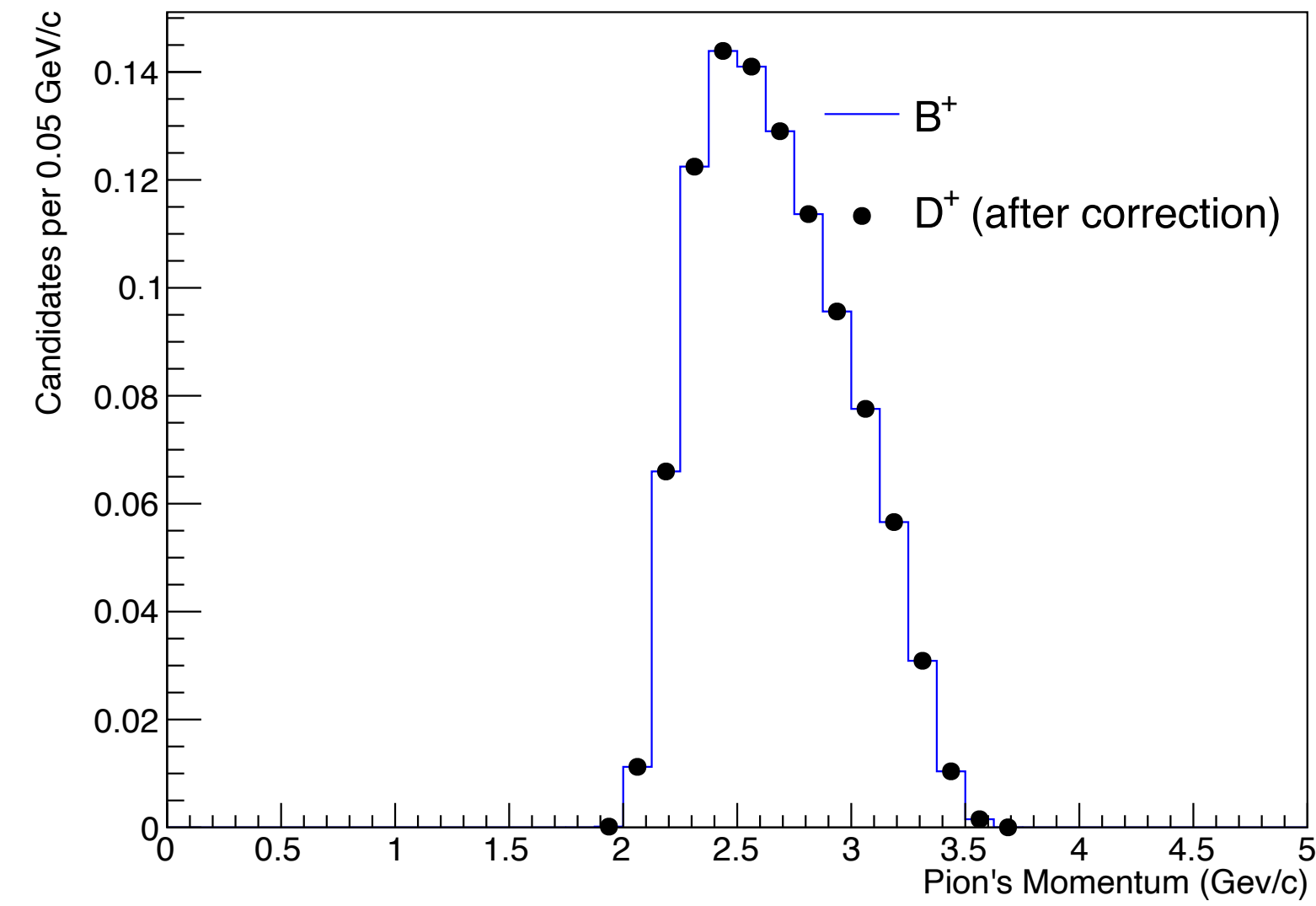
Bin1: $20 < \text{hits} < 40$



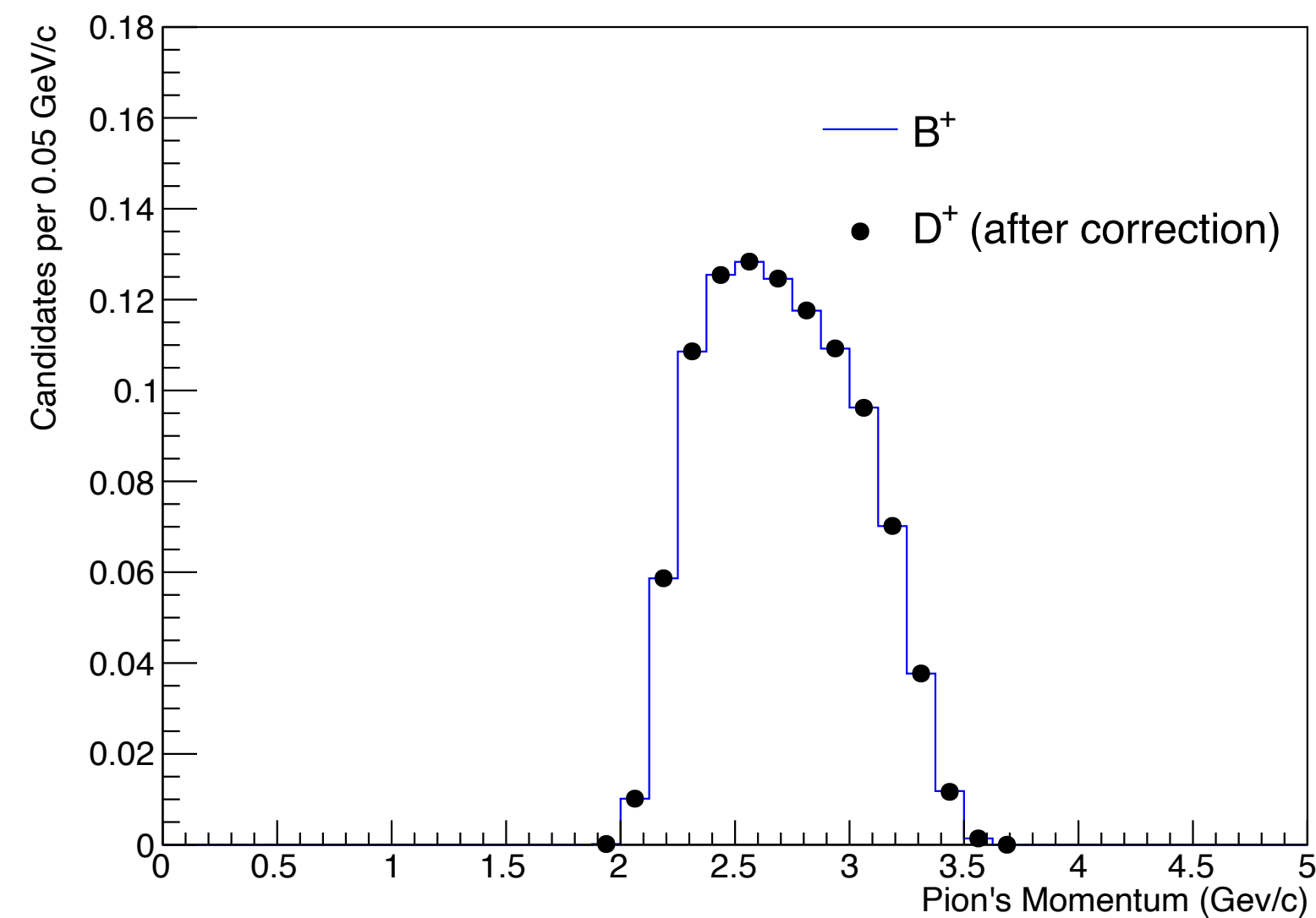
Bin2: $40 \leq \text{hits} < 46$



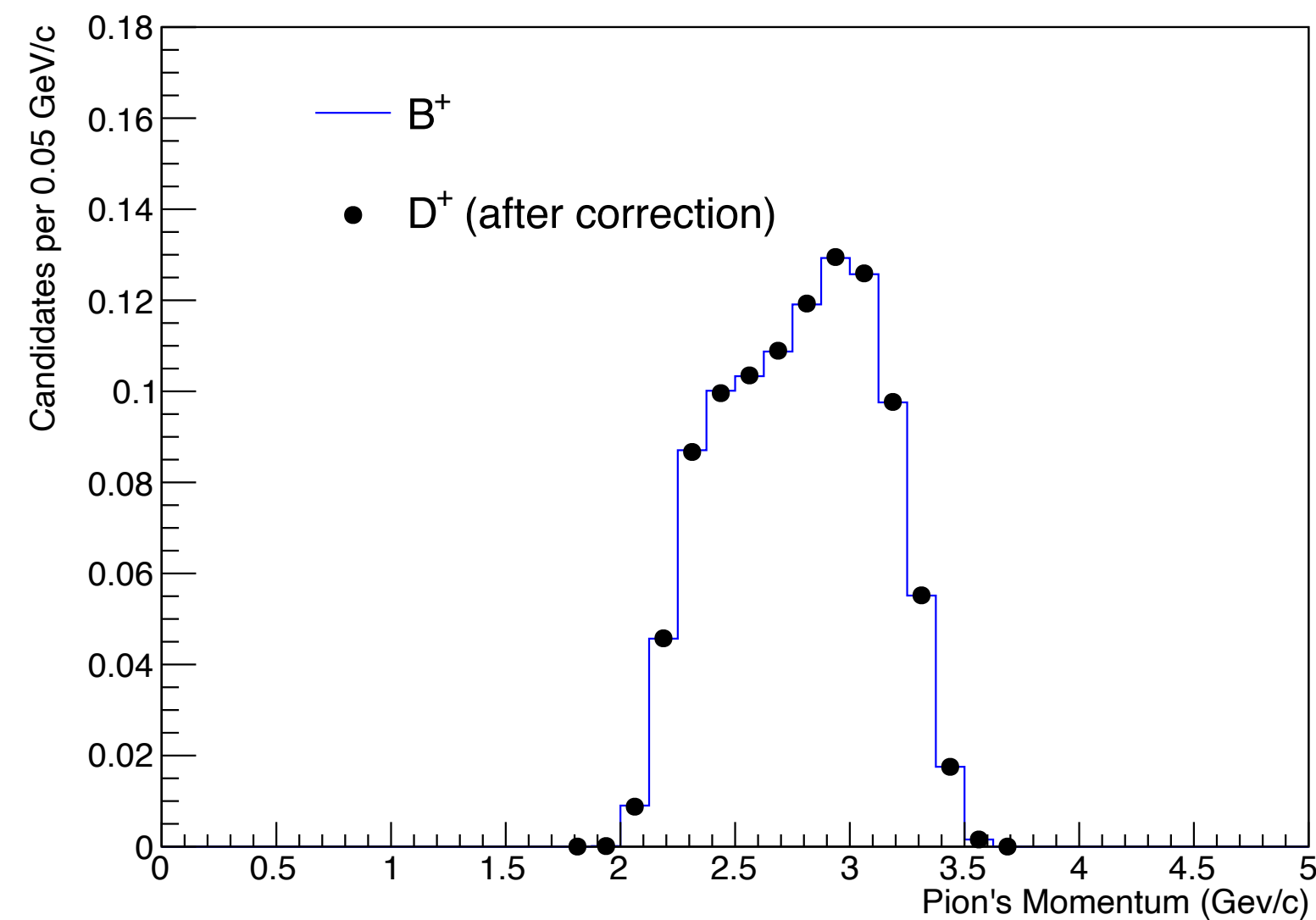
Bin3: $46 \leq \text{hits} < 49$



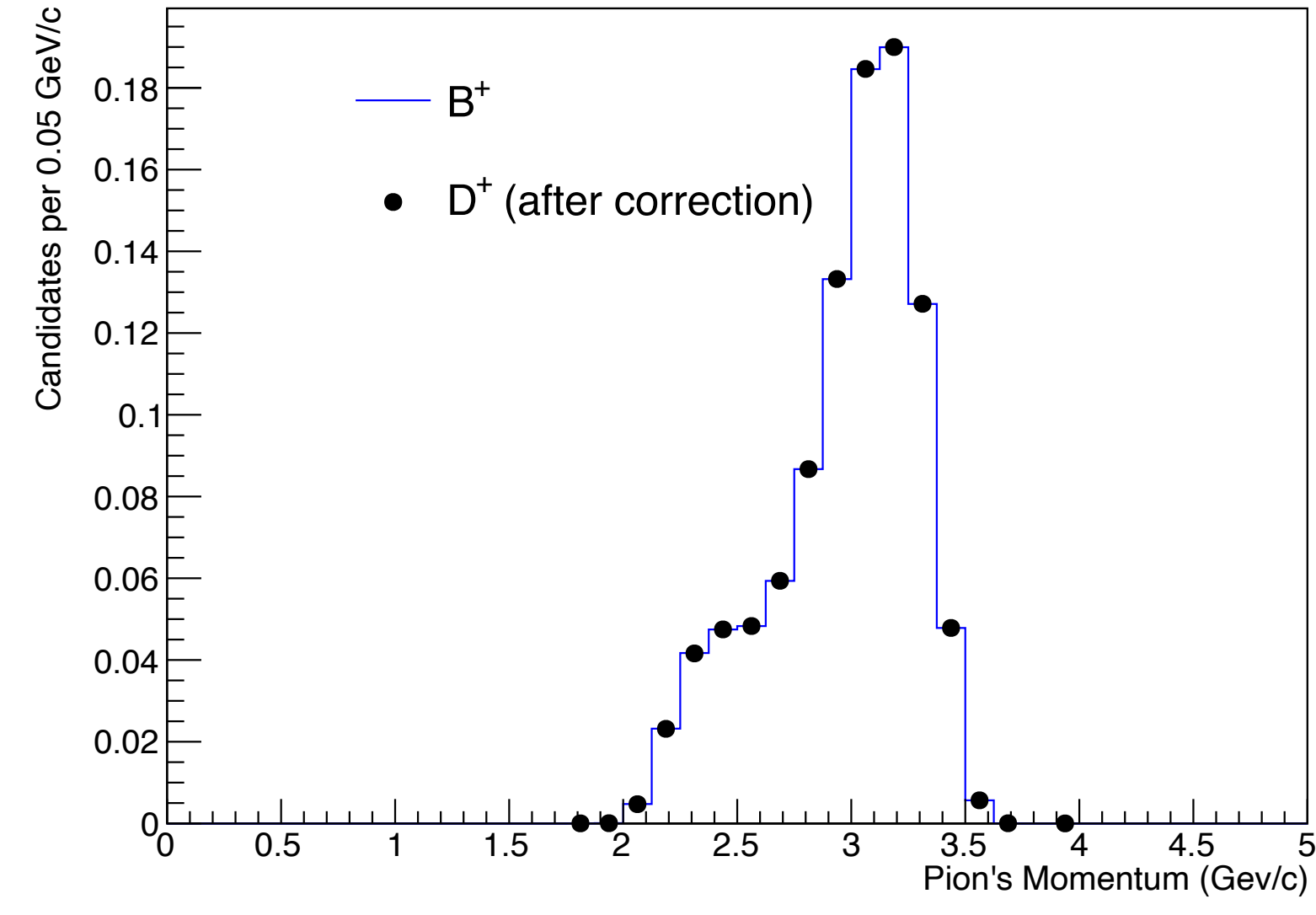
Bin4: $49 \leq \text{hits} < 51$



Bin5: $51 \leq \text{hits} < 53$

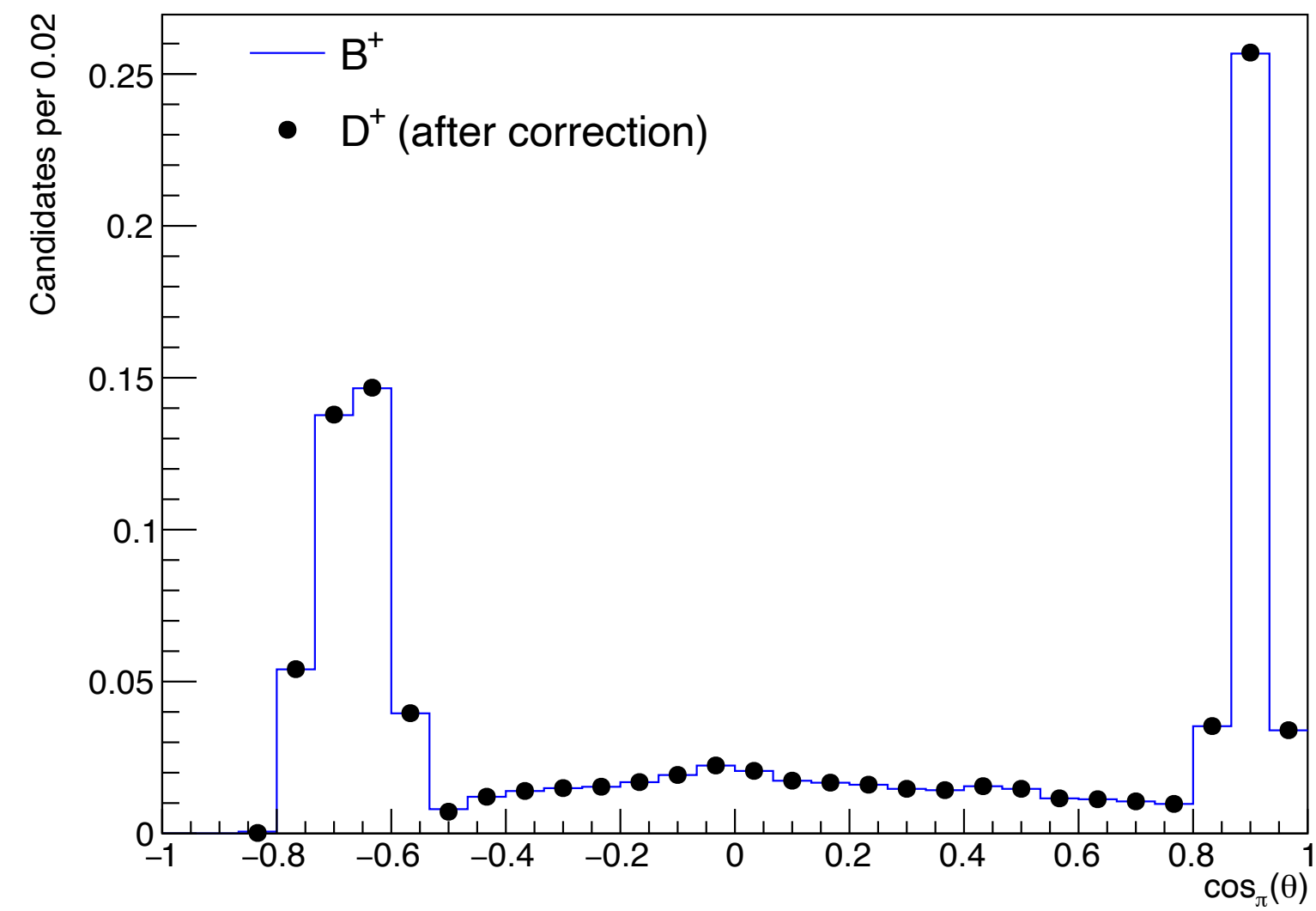


Bin6: $\text{hits} \geq 53$

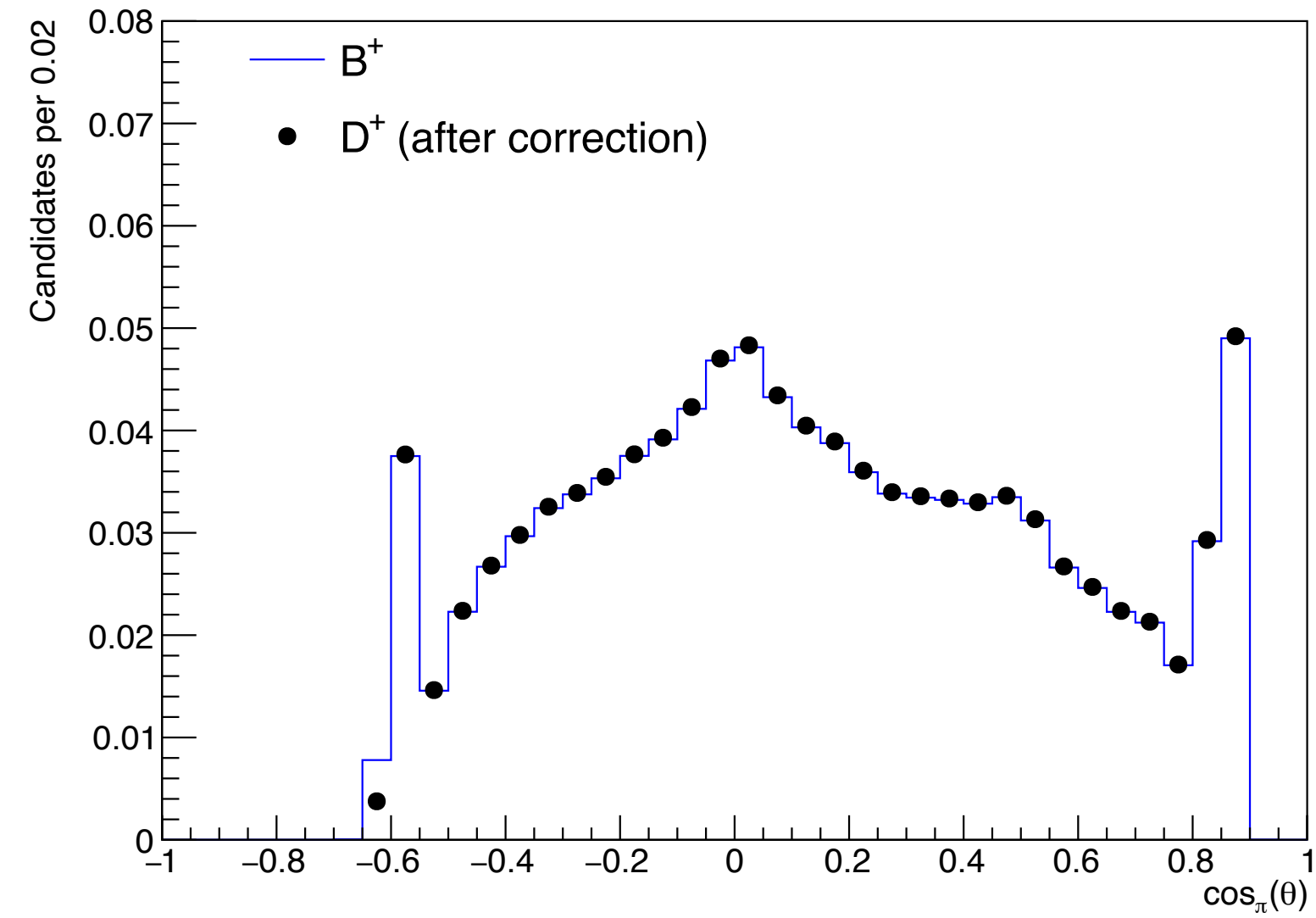


$\cos_{\pi}(\theta)$ distribution

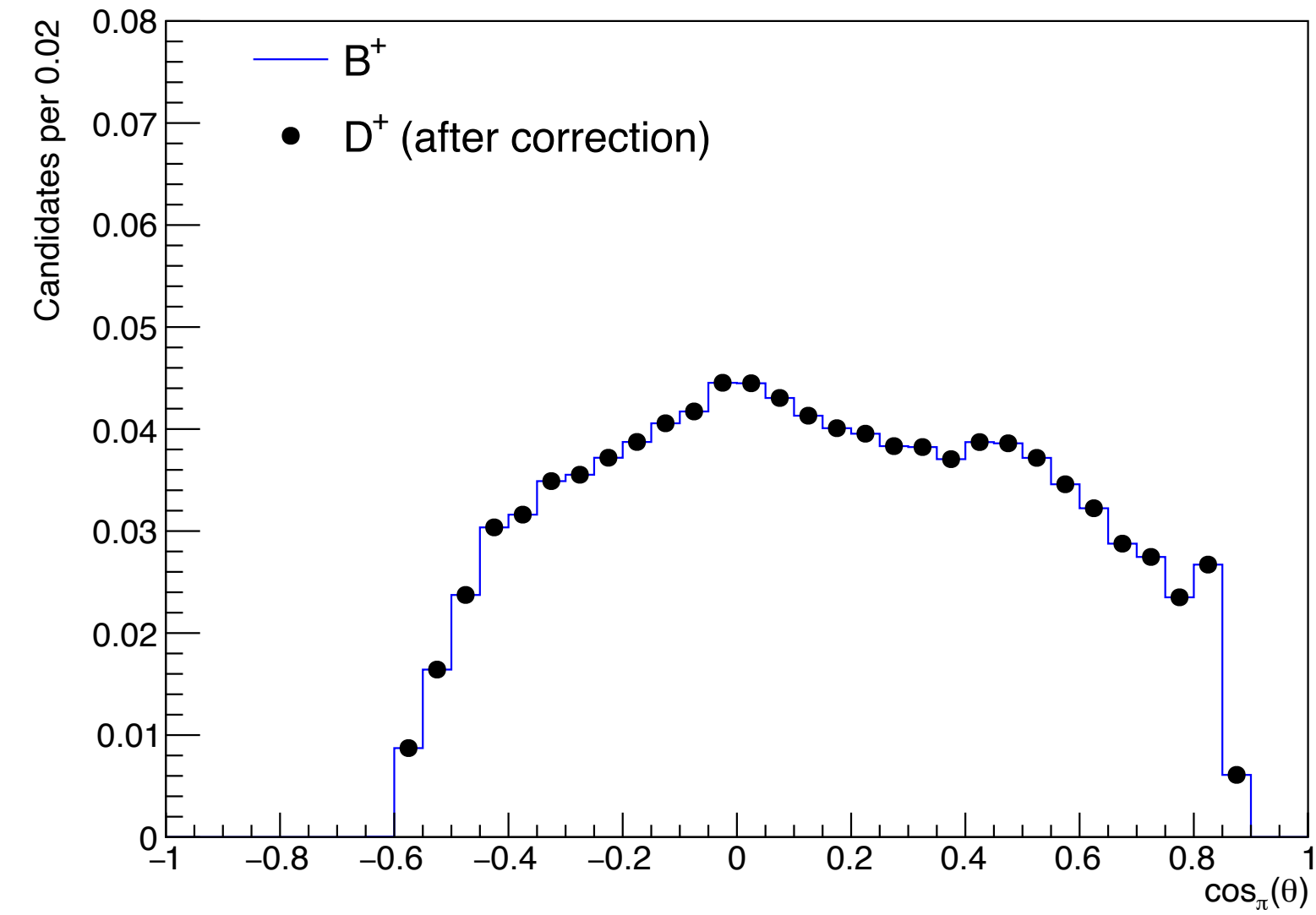
Bin1: $20 < \text{hits} < 40$



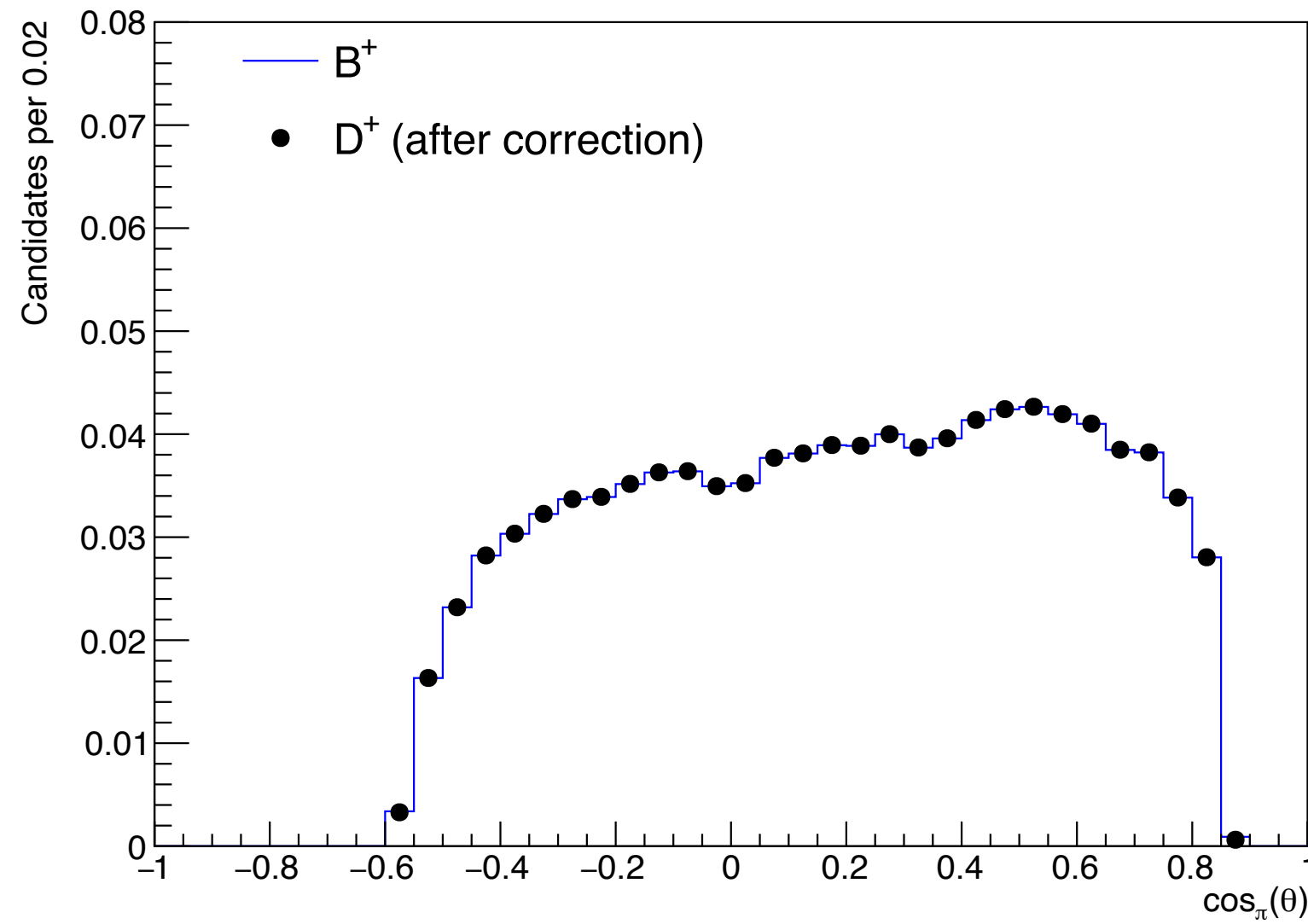
Bin2: $40 \leq \text{hits} < 46$



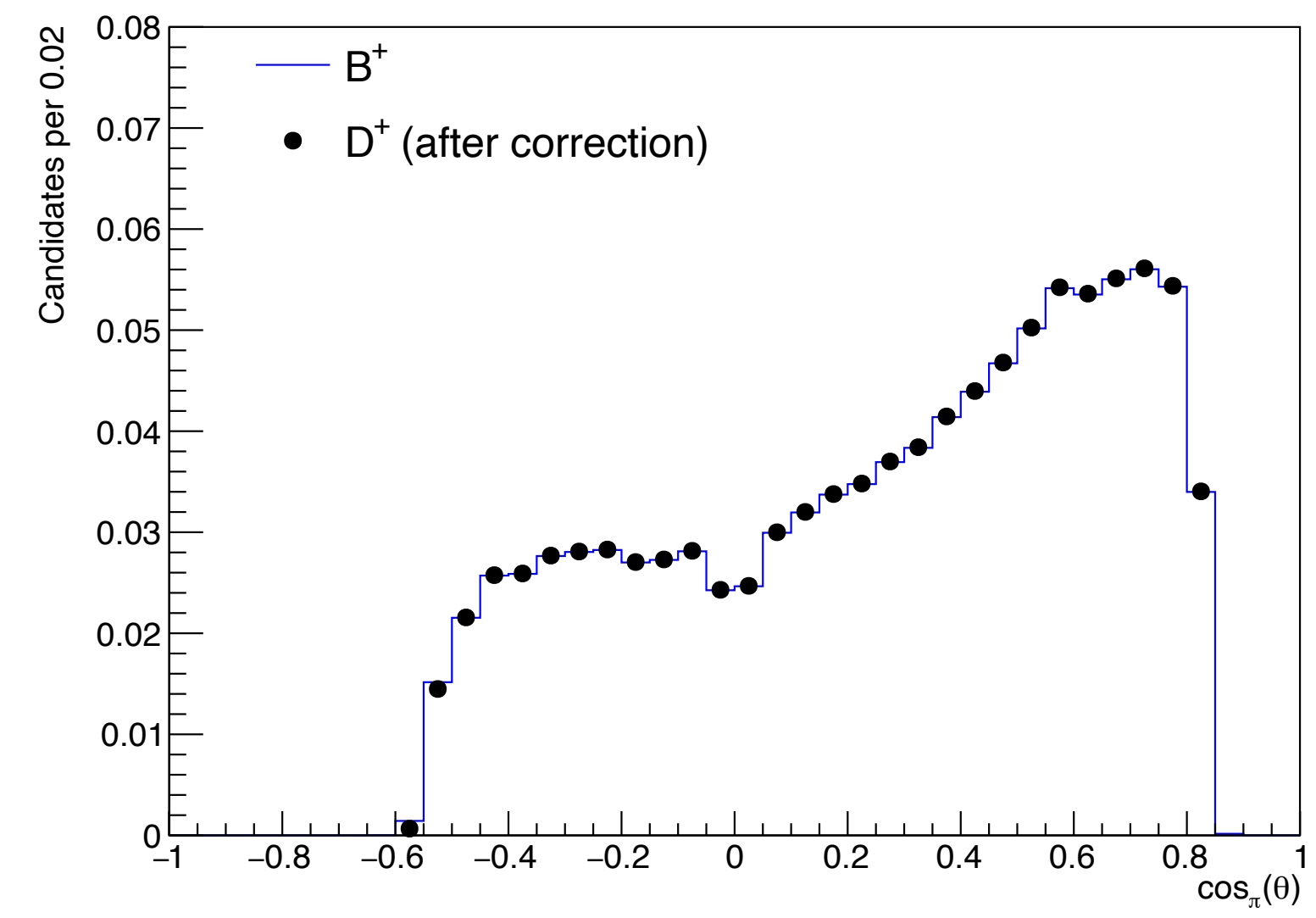
Bin3: $46 \leq \text{hits} < 49$



Bin4: $49 \leq \text{hits} < 51$



Bin5: $51 \leq \text{hits} < 53$



Bin6: $\text{hits} \geq 53$

