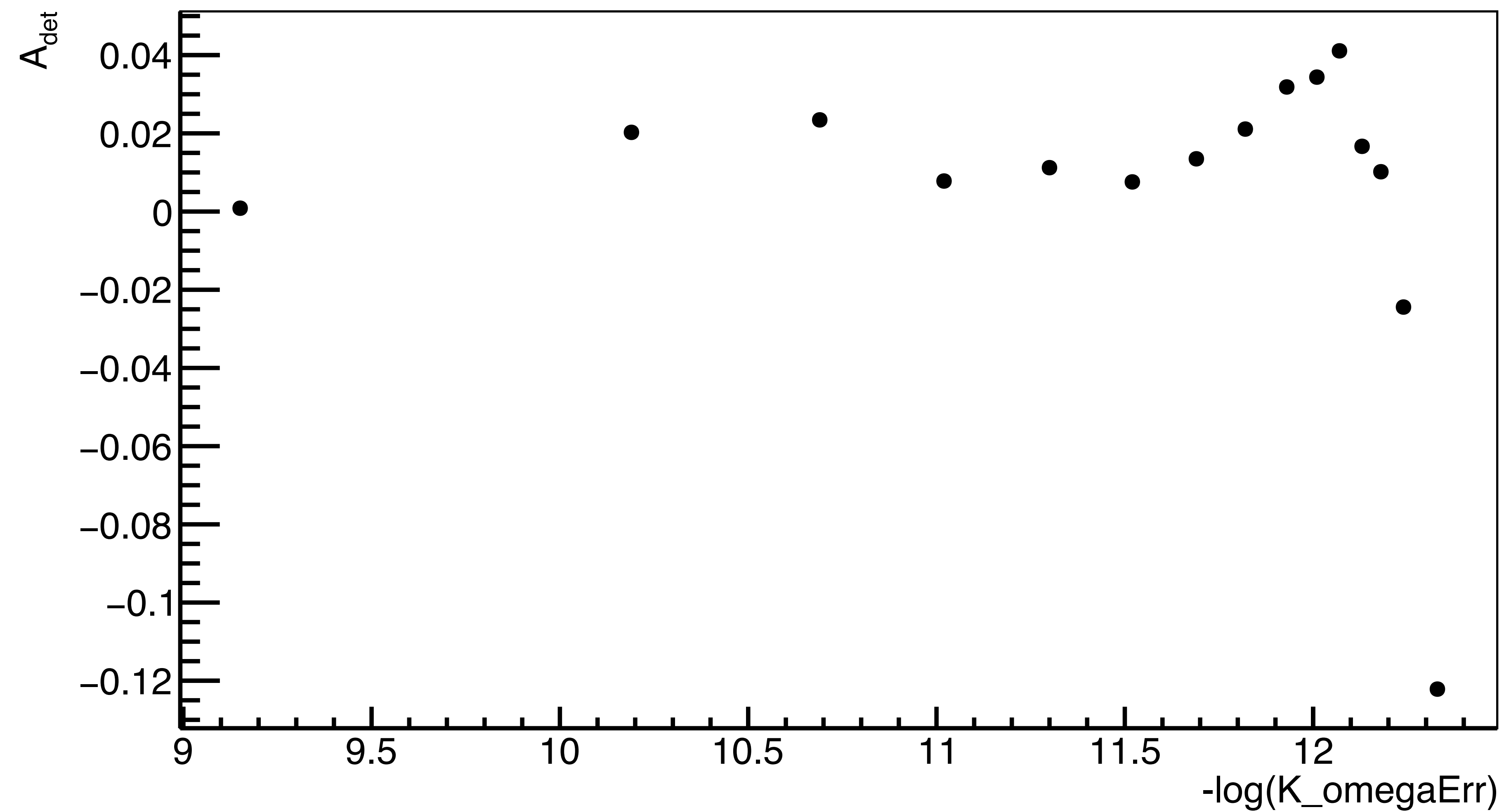


Dependency check on $\Delta\omega_K$ in signalMC

$\mathcal{A}_{det}(K\pi)$ vs $\Delta\omega_K$ in MC



$D^0 \rightarrow K\pi$

- No CS cut
- KaonID > 0.25
- K_nCDCHits > 20

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

Target sample: $D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.8, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0129 \pm 0.0005 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = 0.0035 \pm 0.0004 \text{ (initial value)}$$

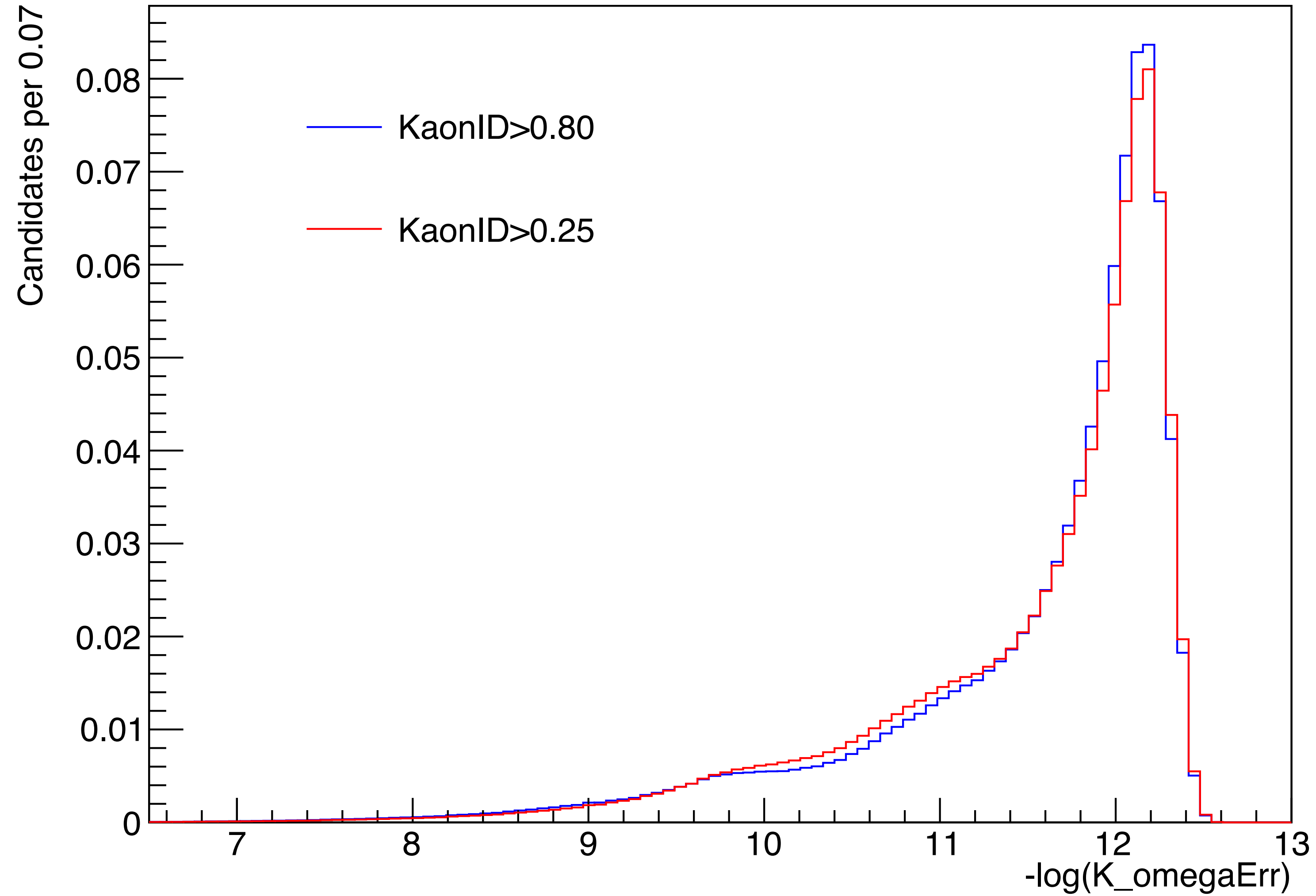
After reweighing (p_K , $\cos_K(\theta)$, $\Delta\omega_K$) distributions according to the target:

$D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.25, K_nCDCHits > 20) gives,

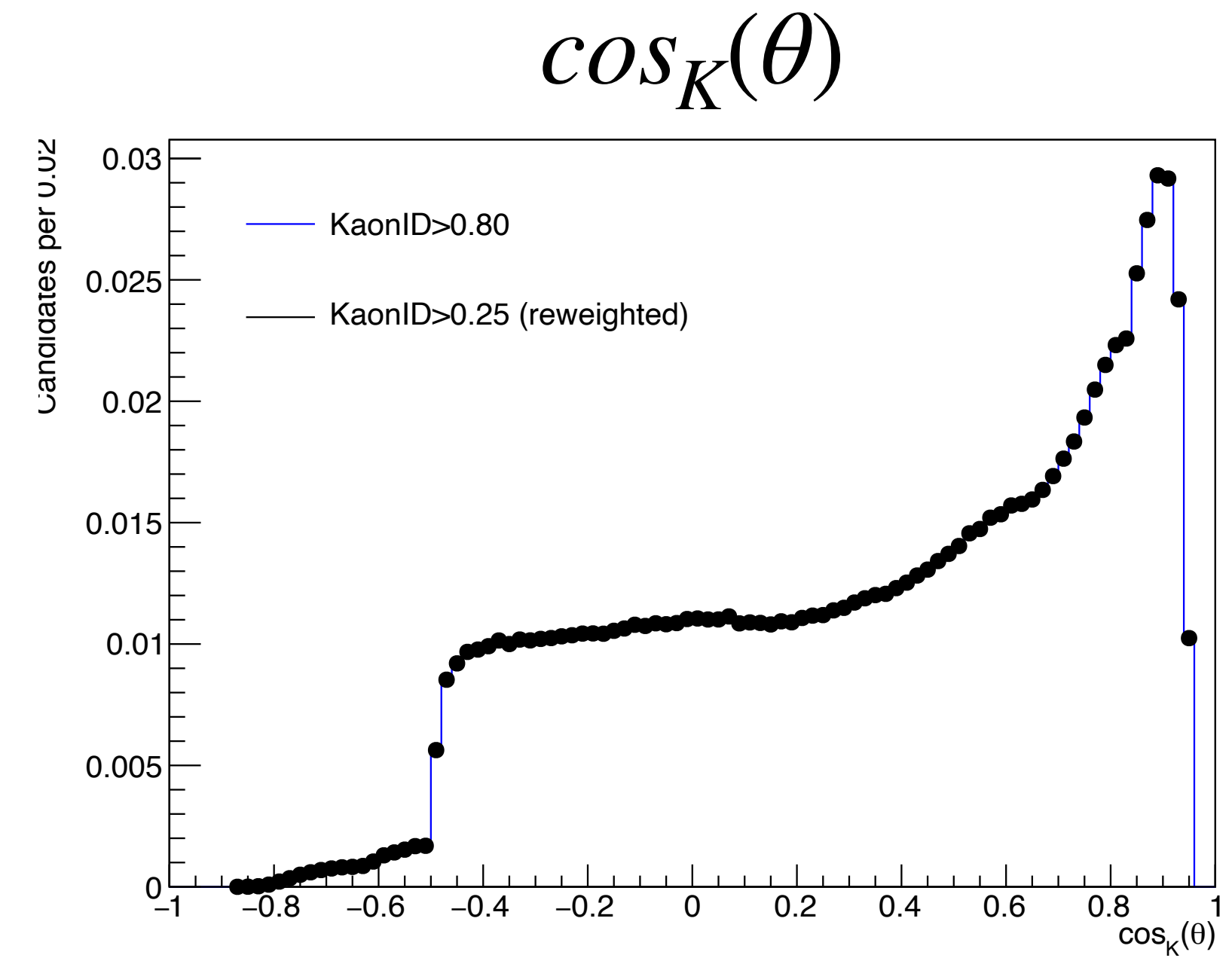
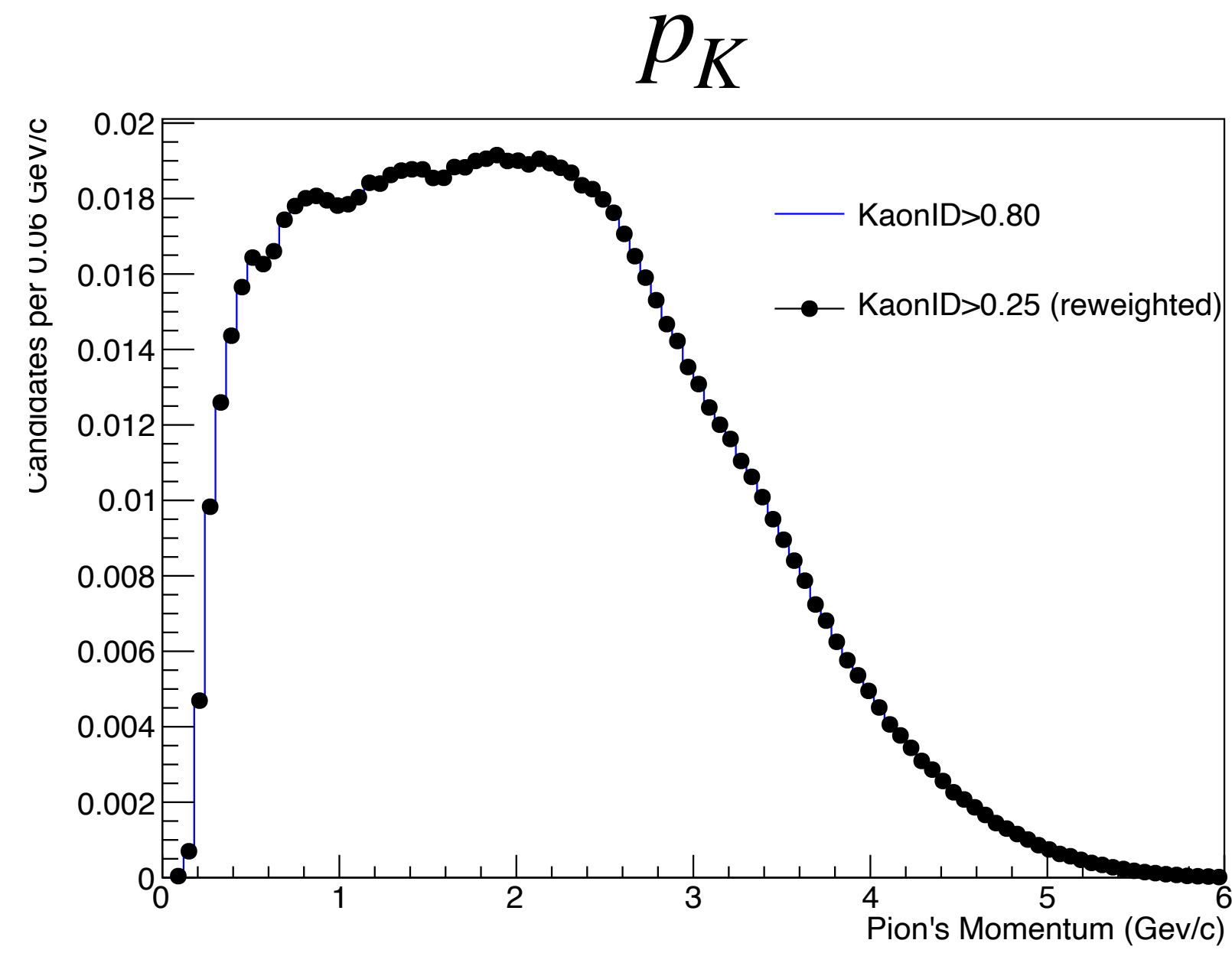
$$\mathcal{A}_{det}(K\pi) = -0.0094 \pm 0.0004 \text{ (corrected value) } (\sim 5\sigma \text{ away})$$

Disagreement

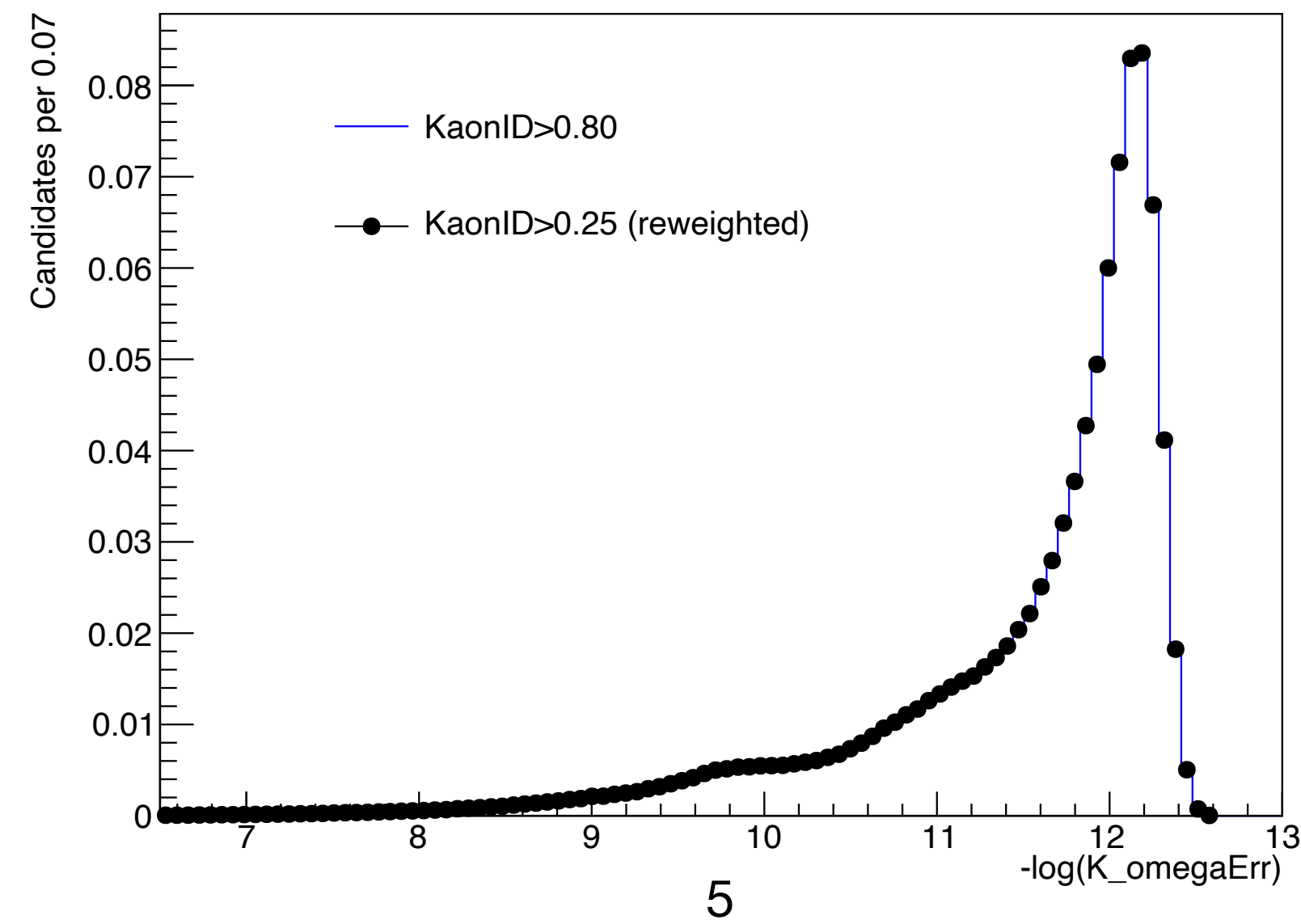
Comparison of $\Delta\omega_K$ distribution in MC



Reweighted distributions in MC

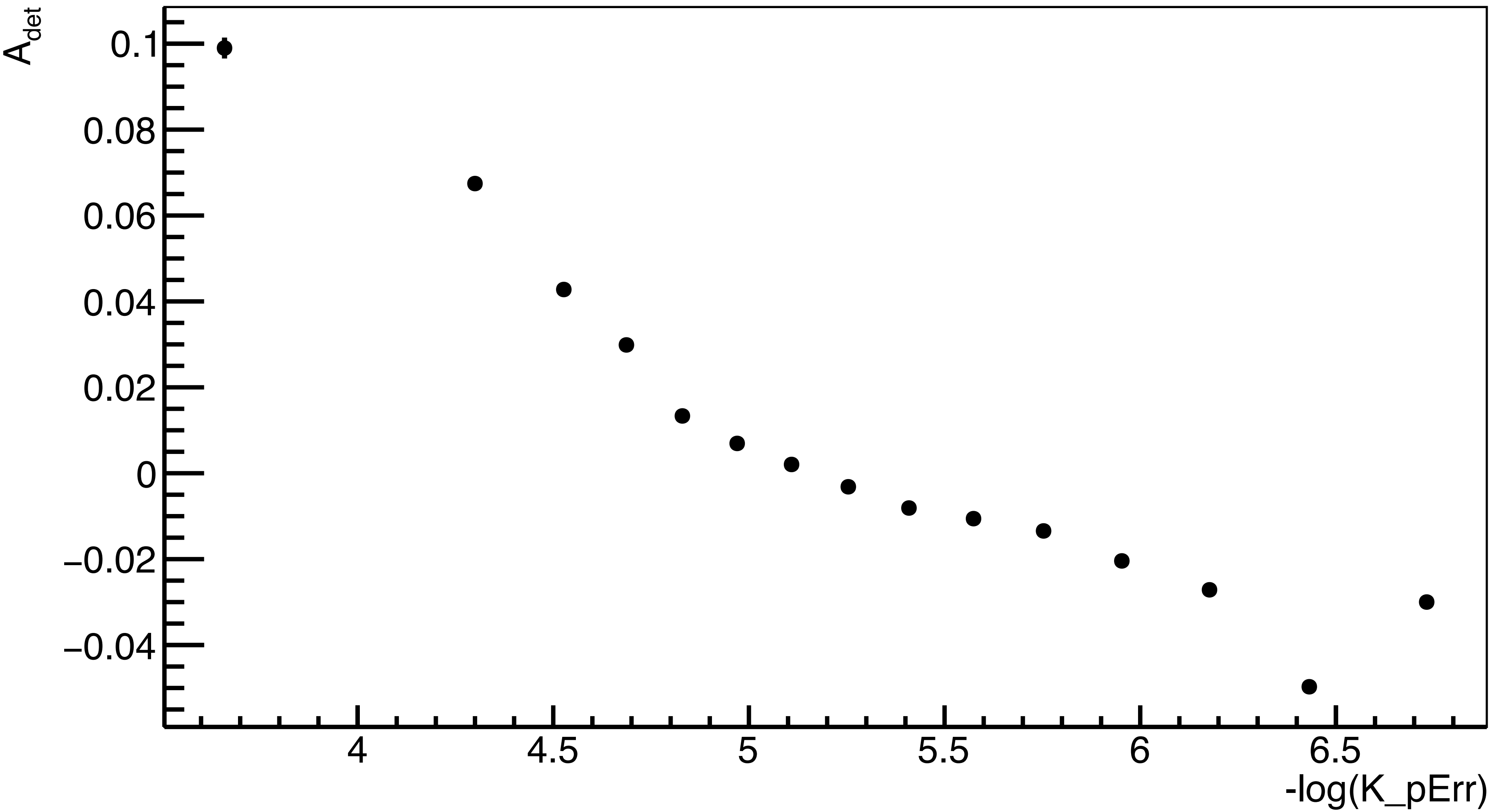


$-\log(\Delta\omega_K)$



Dependency check on Δp_K in signalMC

$\mathcal{A}_{det}(K\pi)$ vs Δp_K in MC



$D^0 \rightarrow K\pi$

- No CS cut
- KaonID > 0.25
- K_nCDCHits > 20

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

Target sample: $D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.80, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0129 \pm 0.0005 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = 0.0035 \pm 0.0004 \text{ (initial value)}$$

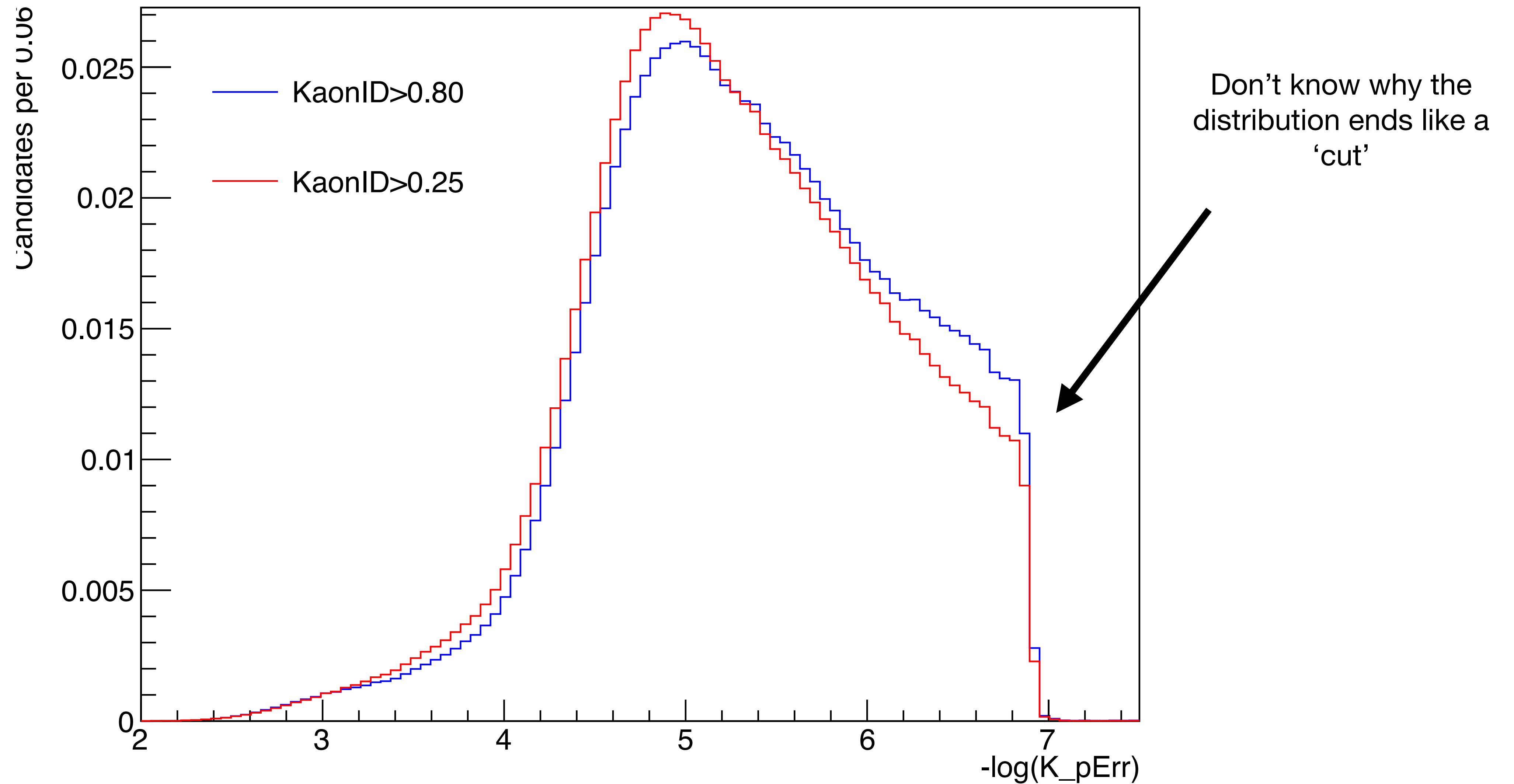
After reweighing ($p_K, \cos_K(\theta), \Delta p_K$) distributions according to the target:

$D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.25, K_nCDCHits > 20) gives,

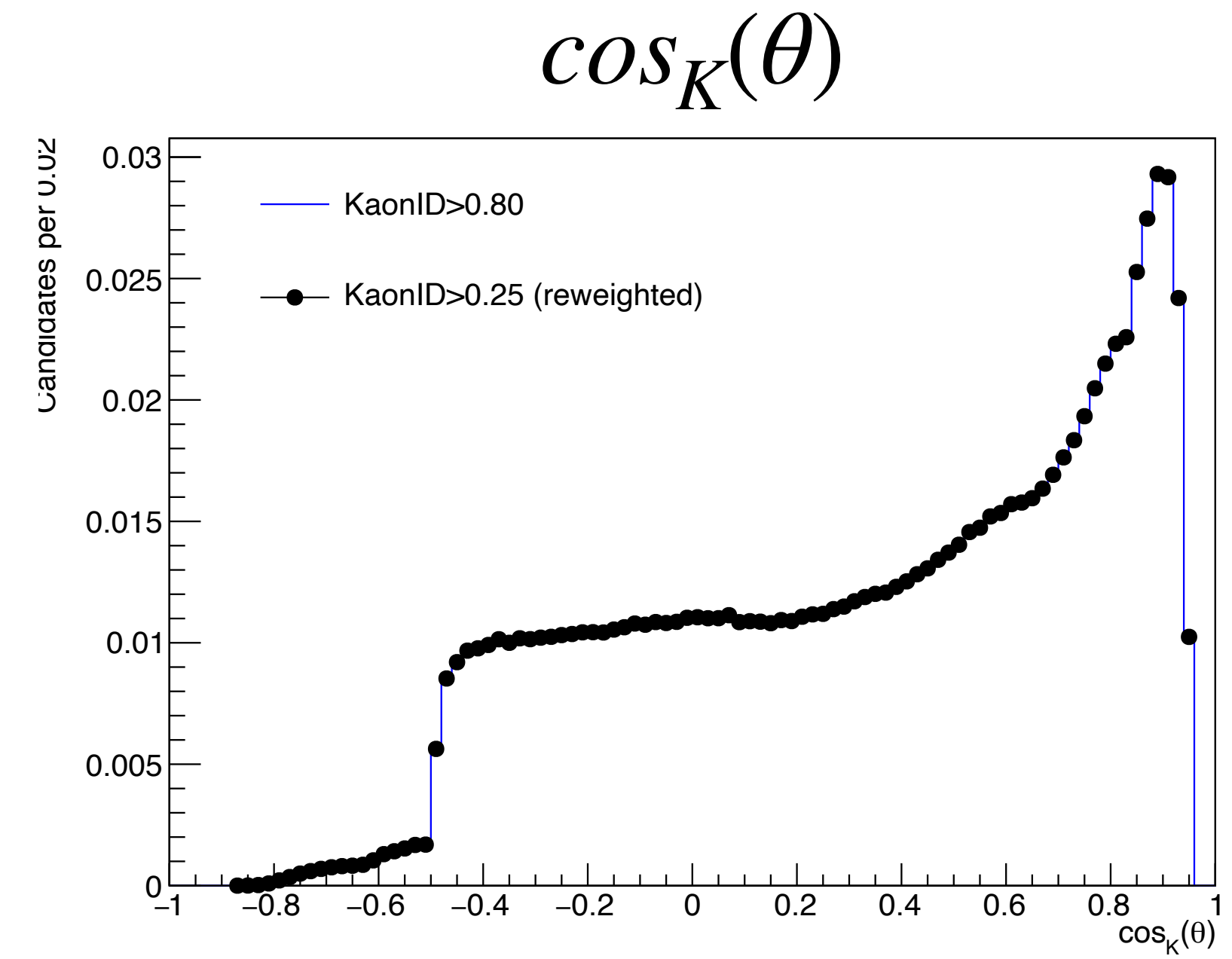
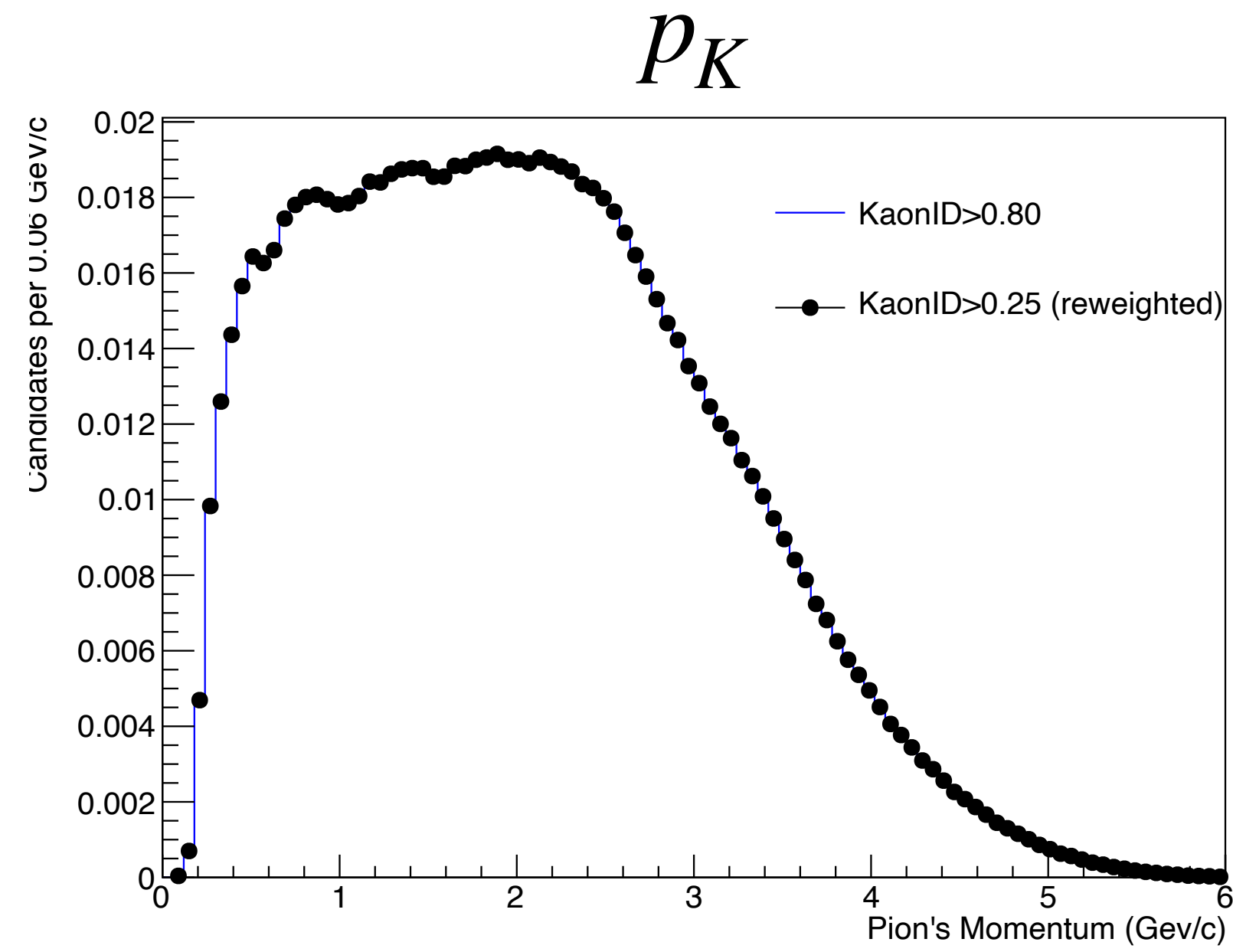
$$\mathcal{A}_{det}(K\pi) = -0.0097 \pm 0.0004 \text{ (corrected value) } (\sim 5\sigma \text{ away})$$

Disagreement

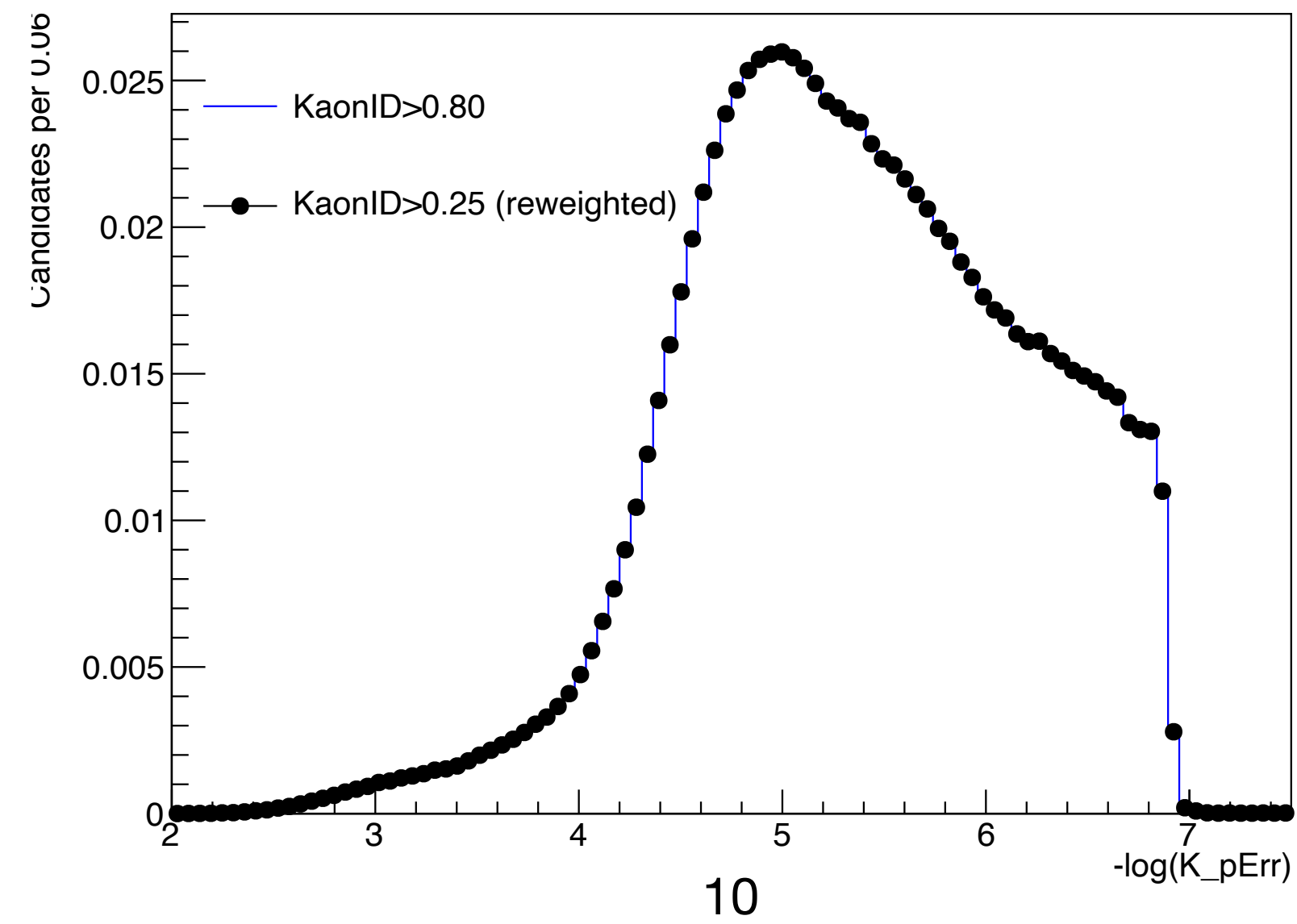
Comparison of Δp_K distribution in MC



Reweighted distributions in MC



$-\log(\Delta p_K)$



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

Test: different PID cut

Target sample: $D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.80, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0129 \pm 0.0005 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (no CS cut, KaonID > 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = 0.0035 \pm 0.0004 \text{ (initial value)}$$

- Reweighting ($p_K, \cos_K(\theta), \Delta\omega_K$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0094 \pm 0.0004$
- Reweighting ($p_K, \cos_K(\theta), \Delta p_K$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0097 \pm 0.0004$
- Reweighting ($p_K, \cos_K(\theta), \text{CDC hits}$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0079 \pm 0.0004$
- Reweighting ($p_K, \cos_K(\theta)$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0085 \pm 0.0004$

$\mathcal{A}_{det}(K\pi)$ closure-test with MC: CS>0.5

Test: different PID cut

Target sample: $D^0 \rightarrow K\pi$ (CS>0.5, KaonID> 0.80, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0255 \pm 0.0008 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (CS>0.5, KaonID> 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0114 \pm 0.0007 \text{ (initial value)}$$

- Reweighting ($p_K, \cos_K(\theta), \Delta\omega_K$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0227 \pm 0.0007 (2.6\sigma)$
- Reweighting ($p_K, \cos_K(\theta), \Delta p_K$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0228 \pm 0.0007 (2.5\sigma)$
- Reweighting ($p_K, \cos_K(\theta), \text{CDC hits}$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0211 \pm 0.0007 (4.1\sigma)$
- Reweighting ($p_K, \cos_K(\theta)$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0216 \pm 0.0007 (3.7\sigma)$

$\mathcal{A}_{det}(K\pi)$ closure-test with MC: kaonID>0.25

Test: different CS cut

Target sample: $D^0 \rightarrow K\pi$ (CS>0.95, KaonID> 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0304 \pm 0.0019 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (CS>0.5, KaonID> 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0114 \pm 0.0007 \text{ (initial value)}$$

- Reweighting ($p_K, \cos_K(\theta), \Delta p_K$) distributions: $\mathcal{A}_{det}(K\pi) = -0.0170 \pm 0.0007$

Disagreement

$\mathcal{A}_{det}(K\pi)$ closure-test with MC: Binning in Δp_K

Test: different PID cut

Target sample: $D^0 \rightarrow K\pi$ (CS>0.5, KaonID> 0.80, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0255 \pm 0.0008 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (CS>0.5, KaonID> 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0114 \pm 0.0007 \text{ (initial value)}$$

Average according to Δp_K of the target after correcting $(p_K, \cos_K(\theta))$ distribution in each bins (5 bins) of Δp_K : $\mathcal{A}_{det}(K\pi) = -0.0213 \pm 0.0007 (4\sigma)$

Disagreement

$\mathcal{A}_{det}(K\pi)$ closure-test with MC: Binning in Δp_K

Test: different CS cut

Target sample: $D^0 \rightarrow K\pi$ (CS>0.95, KaonID> 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0304 \pm 0.0019 \text{ (target)}$$

Control sample: $D^0 \rightarrow K\pi$ (CS>0.50, KaonID> 0.25, K_nCDCHits > 20)

$$\mathcal{A}_{det}(K\pi) = -0.0114 \pm 0.0007 \text{ (initial value)}$$

Average according to Δp_K of the target after correcting $(p_K, \cos_K(\theta))$ distribution in each bins (5 bins) of Δp_K : $\mathcal{A}_{det}(K\pi) = -0.0118 \pm 0.0007$

Disagreement

Summary of $\mathcal{A}_{det}(K\pi)$ closure test with MC

- 3D reweighting with $(p_K, \cos_K(\theta), \Delta p_K)$ or with $(p_K, \cos_K(\theta), \Delta\omega_K)$ is unstable with different CS cuts.
- Also, with our weighted average methods in bins of Δp_K , we couldn't reach to target's asymmetry value (far away)

About the note

- Discussion required, especially the reweighting part
- Convert all the plots into “Belle II style” (to do)