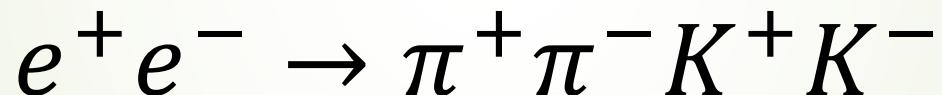


# Tracking efficiency for XYZ data



1

2

$$\varepsilon = \frac{n}{N}$$

$N : (\text{nGood} = 3) \parallel (\text{nGood} = 4)$

for  $\pi^+$ , at least have a  $\pi^-$ ,  $K^+$ ,  $K^-$

for  $\pi^-$ , at least have a  $\pi^+$ ,  $K^+$ ,  $K^-$

for  $K^+$ , at least have a  $\pi^+$ ,  $\pi^-$ ,  $K^-$

for  $K^-$ , at least have a  $\pi^+$ ,  $\pi^-$ ,  $K^+$

$n : \text{nGood} = 4$

Good track :  $|R_{xy}| < 1\text{cm}$ ,  $|R_z| < 10\text{cm}$ ,  $|\cos\theta| < 0.93$

$\pi : P_\pi > P_K, P_\pi > P_p, P_\pi > 0.001, E_{emc} < 1 \text{ GeV}$

$K : P_K > P_\pi, P_K > P_p, P_K > 0.001, E_{emc} < 1 \text{ GeV}$

Boss version : 7.0.2.p01

Data : 4.19 GeV, 4.20 GeV, 4.21 GeV, 4.22 GeV, 4.237 GeV, 4.247 GeV,  
4.27 GeV

3

$\pi^+$

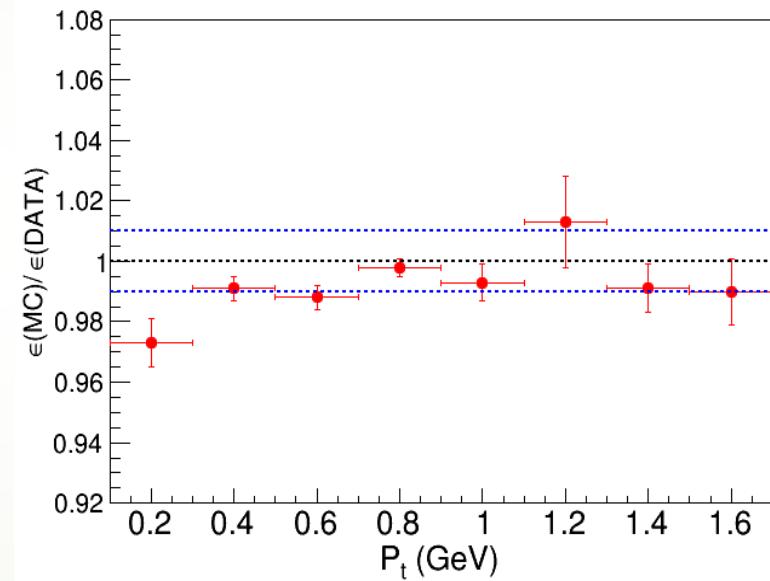
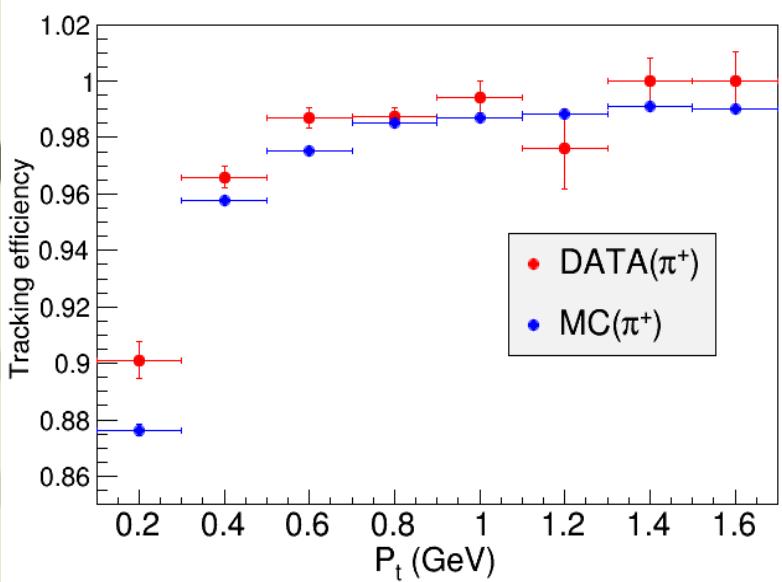
$$\Delta \varepsilon = 1 - \varepsilon^{MC} / \varepsilon^{data}$$

4

$$\sigma_{\varepsilon^{data}} = \frac{1}{N} \sqrt{(1 - 2\varepsilon^{data})\sigma_n^2 + \varepsilon^{data^2}\sigma_N^2}$$

$$\sigma_{\varepsilon^{MC}} = \sqrt{\frac{\varepsilon^{MC}(1 - \varepsilon^{MC})}{N}}$$

$P_t(\text{GeV})$	$\varepsilon^{data}(\%)$	$\varepsilon^{MC}(\%)$	$\varepsilon^{MC}/\varepsilon^{data}$	$\Delta \varepsilon(\%)$
(0.1, 0.3)	$90.11 \pm 0.66$	$87.64 \pm 0.21$	$0.973 \pm 0.008$	$2.7 \pm 0.8$
(0.3, 0.5)	$96.60 \pm 0.39$	$95.75 \pm 0.10$	$0.991 \pm 0.004$	$0.9 \pm 0.4$
(0.5, 0.7)	$98.69 \pm 0.36$	$97.54 \pm 0.07$	$0.988 \pm 0.004$	$1.2 \pm 0.4$
(0.7, 0.9)	$98.74 \pm 0.31$	$98.53 \pm 0.06$	$0.998 \pm 0.003$	$0.2 \pm 0.3$
(0.9, 1.1)	$99.43 \pm 0.56$	$98.70 \pm 0.06$	$0.993 \pm 0.006$	$0.7 \pm 0.6$
(1.1, 1.3)	$97.60 \pm 1.41$	$98.84 \pm 0.07$	$1.013 \pm 0.015$	$-1.3 \pm 1.5$
(1.3, 1.5)	$100.00 \pm 0.82$	$99.09 \pm 0.08$	$0.991 \pm 0.008$	$0.9 \pm 0.8$
(1.5, 1.7)	$100.00 \pm 1.06$	$99.01 \pm 0.11$	$0.990 \pm 0.011$	$1.0 \pm 1.1$



6

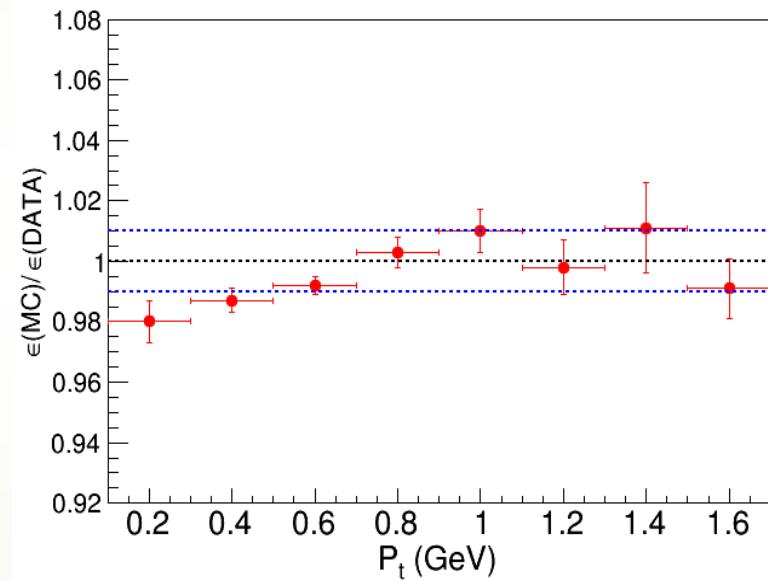
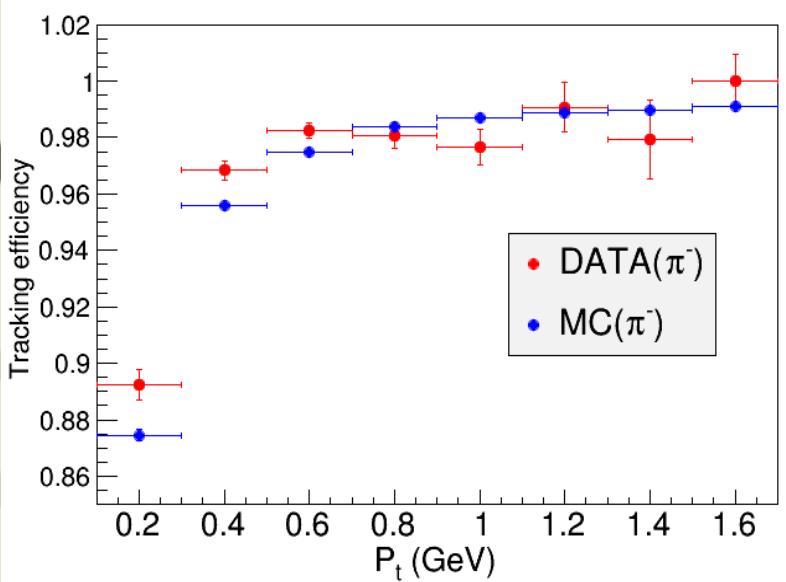
$\pi^-$

$$\Delta \varepsilon = 1 - \varepsilon^{MC} / \varepsilon^{data}$$

$$\sigma_{\varepsilon^{data}} = \frac{1}{N} \sqrt{(1 - 2\varepsilon^{data})\sigma_n^2 + \varepsilon^{data^2}\sigma_N^2}$$

$$\sigma_{\varepsilon^{MC}} = \sqrt{\frac{\varepsilon^{MC}(1 - \varepsilon^{MC})}{N}}$$

$P_t(\text{GeV})$	$\varepsilon^{data}(\%)$	$\varepsilon^{MC}(\%)$	$\varepsilon^{MC}/\varepsilon^{data}$	$\Delta \varepsilon(\%)$
(0.1, 0.3)	$89.24 \pm 0.55$	$87.46 \pm 0.21$	$0.980 \pm 0.007$	$2.0 \pm 0.7$
(0.3, 0.5)	$96.83 \pm 0.33$	$95.60 \pm 0.10$	$0.987 \pm 0.004$	$1.3 \pm 0.4$
(0.5, 0.7)	$98.24 \pm 0.28$	$97.46 \pm 0.07$	$0.992 \pm 0.003$	$0.8 \pm 0.3$
(0.7, 0.9)	$98.05 \pm 0.45$	$98.37 \pm 0.06$	$1.003 \pm 0.005$	$-0.3 \pm 0.5$
(0.9, 1.1)	$97.66 \pm 0.65$	$98.68 \pm 0.06$	$1.010 \pm 0.007$	$-1.0 \pm 0.7$
(1.1, 1.3)	$99.08 \pm 0.89$	$98.88 \pm 0.07$	$0.998 \pm 0.009$	$0.2 \pm 0.9$
(1.3, 1.5)	$97.92 \pm 1.40$	$98.97 \pm 0.08$	$1.011 \pm 0.015$	$-1.1 \pm 1.5$
(1.5, 1.7)	$100.00 \pm 0.93$	$99.12 \pm 0.11$	$0.991 \pm 0.010$	$0.9 \pm 1.0$



9

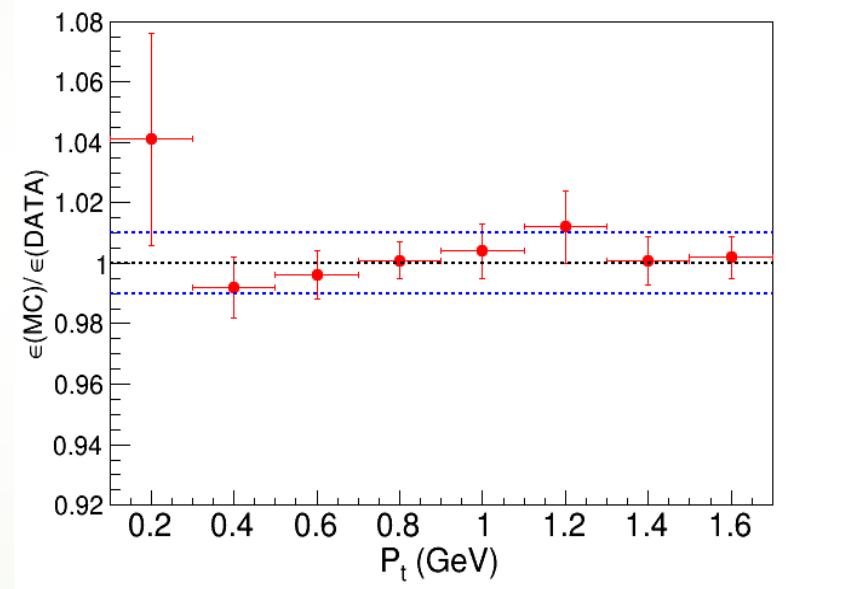
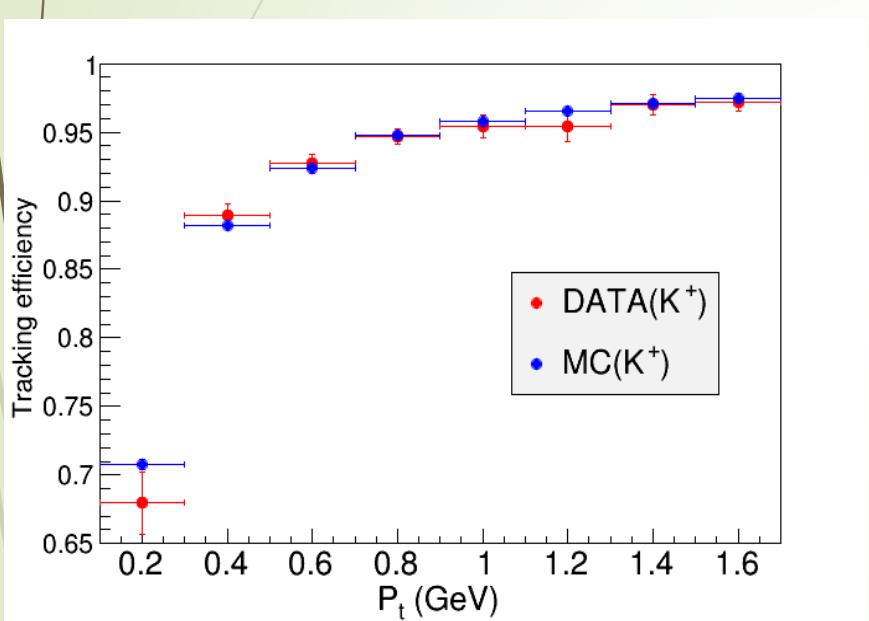
$K^+$

$$\Delta \varepsilon = 1 - \varepsilon^{MC} / \varepsilon^{data}$$

$$\sigma_{\varepsilon^{data}} = \frac{1}{N} \sqrt{(1 - 2\varepsilon^{data})\sigma_n^2 + \varepsilon^{data^2}\sigma_N^2}$$

$$\sigma_{\varepsilon^{MC}} = \sqrt{\frac{\varepsilon^{MC}(1 - \varepsilon^{MC})}{N}}$$

$P_t(\text{GeV})$	$\varepsilon^{data}(\%)$	$\varepsilon^{MC}(\%)$	$\varepsilon^{MC}/\varepsilon^{data}$	$\Delta \varepsilon(\%)$
(0.1, 0.3)	$67.96 \pm 2.27$	$70.76 \pm 0.38$	$1.041 \pm 0.035$	$-4.1 \pm 3.5$
(0.3, 0.5)	$88.90 \pm 0.86$	$88.16 \pm 0.17$	$0.992 \pm 0.010$	$0.8 \pm 1.0$
(0.5, 0.7)	$92.72 \pm 0.69$	$92.36 \pm 0.12$	$0.996 \pm 0.008$	$0.4 \pm 0.8$
(0.7, 0.9)	$94.71 \pm 0.57$	$94.80 \pm 0.10$	$1.001 \pm 0.006$	$-0.1 \pm 0.6$
(0.9, 1.1)	$95.42 \pm 0.86$	$95.81 \pm 0.10$	$1.004 \pm 0.009$	$-0.4 \pm 0.9$
(1.1, 1.3)	$95.43 \pm 1.10$	$96.56 \pm 0.10$	$1.012 \pm 0.012$	$-1.2 \pm 1.2$
(1.3, 1.5)	$97.01 \pm 0.72$	$97.06 \pm 0.11$	$1.001 \pm 0.008$	$-0.1 \pm 0.8$
(1.5, 1.7)	$97.19 \pm 0.64$	$97.43 \pm 0.14$	$1.002 \pm 0.007$	$-0.2 \pm 0.7$



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$K^-$

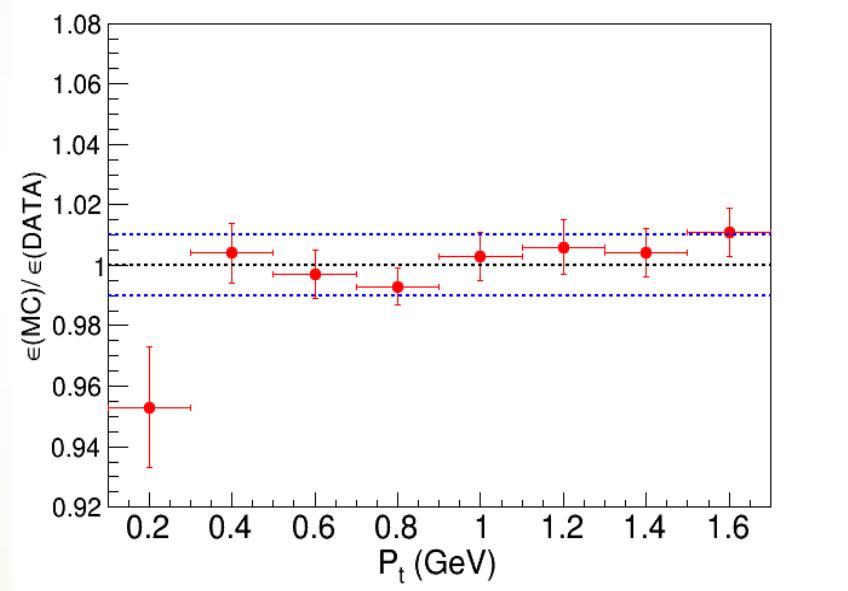
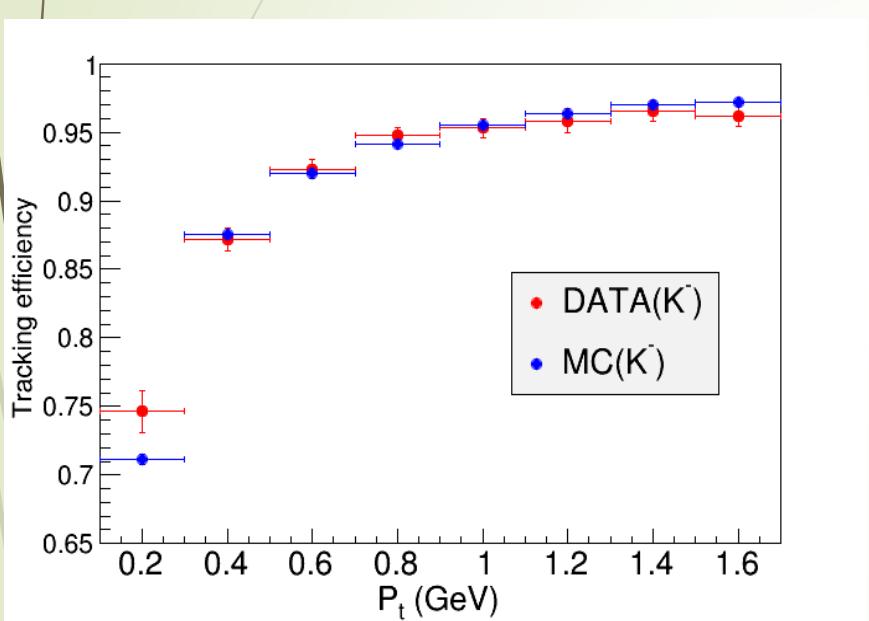
$$\Delta \varepsilon = 1 - \varepsilon^{MC} / \varepsilon^{data}$$

13

$$\sigma_{\varepsilon^{data}} = \frac{1}{N} \sqrt{(1 - 2\varepsilon^{data})\sigma_n^2 + \varepsilon^{data^2}\sigma_N^2}$$

$$\sigma_{\varepsilon^{MC}} = \sqrt{\frac{\varepsilon^{MC}(1 - \varepsilon^{MC})}{N}}$$

$P_t(\text{GeV})$	$\varepsilon^{data}(\%)$	$\varepsilon^{MC}(\%)$	$\varepsilon^{MC}/\varepsilon^{data}$	$\Delta \varepsilon(\%)$
(0.1, 0.3)	$74.65 \pm 1.52$	$71.12 \pm 0.38$	$0.953 \pm 0.020$	$4.7 \pm 2.0$
(0.3, 0.5)	$87.20 \pm 0.84$	$87.59 \pm 0.17$	$1.004 \pm 0.010$	$-0.4 \pm 1.0$
(0.5, 0.7)	$92.31 \pm 0.71$	$92.04 \pm 0.12$	$0.997 \pm 0.008$	$0.3 \pm 0.8$
(0.7, 0.9)	$94.75 \pm 0.59$	$94.12 \pm 0.11$	$0.993 \pm 0.006$	$0.7 \pm 0.6$
(0.9, 1.1)	$95.30 \pm 0.72$	$95.55 \pm 0.10$	$1.003 \pm 0.008$	$-0.3 \pm 0.8$
(1.1, 1.3)	$95.81 \pm 0.89$	$96.34 \pm 0.10$	$1.006 \pm 0.009$	$-0.6 \pm 0.9$
(1.3, 1.5)	$96.57 \pm 0.75$	$97.00 \pm 0.11$	$1.004 \pm 0.008$	$-0.4 \pm 0.8$
(1.5, 1.7)	$96.15 \pm 0.73$	$97.22 \pm 0.15$	$1.011 \pm 0.008$	$-1.1 \pm 0.8$



# Summary

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1. Tracking efficiency for  $\pi^+$ ,  $\pi^-$ ,  $K^+$  and  $K^-$  is studied using control sample  $e^+e^- \rightarrow \pi^+\pi^-K^+K^-$

Thanks for your attention!