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Erratum

Measurements of charged kaon semileptonic decay branching fractions $K^{\pm} \to \pi^0\mu^{\pm}\nu$ and $K^{\pm} \to \pi^0 e^{\pm}\nu$ and their ratio

The NA48/2 Collaboration

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Abstract. In an earlier paper [1], the background for K_{e3} was over estimated due to an erroneous calculation of the electron identification efficiency. The correct ratios of the partial widths involving this channel are $\mathcal{R}_{Ke3/K2\pi} = 0.2470 \pm 0.0009\,(\text{stat}) \pm 0.0004\,(\text{syst})$ and $\mathcal{R}_{K\mu3/Ke3} = 0.663 \pm 0.003\,(\text{stat}) \pm 0.001\,(\text{syst})$. Assuming the PDG value [2] for the $K_{2\pi}$ branching ratio, the measured branching fraction of $\text{Br}\,(K_{e3})$ continues to exceed the current PDG value [2]. The extracted value of $|V_{us}|f_+(0)$ is in agreement with the CKM unitary prediction; thus, our conclusions in [1] do not change.

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In the analysis of charged kaon semileptonic decays presented in an earlier paper [1], the background for K_{e3} was unfortunately overestimated due to an erroneous calculation of the electron identification efficiency. The average electron identification efficiency is corrected to be $(98.59 \pm 0.09)\%$, see Fig. 4a, and this is the only input into the calculation that has been modified. Table 1 lists the corresponding quantities needed to evaluate the branching fractions, and Table 2 lists the expected background, based on the corrected electron identification efficiency.

The updated results of Table 4 in [1] for $\mathcal{R}_{Ke3/K2\pi}$ and $\mathcal{R}_{K\mu3/Ke3}$ are

$$\mathcal{R}_{Ke3/K2\pi} = 0.2476 \pm 0.0011\,(\text{stat}) \pm 0.0005\,(\text{syst}) \quad [K^+]\,,$$
$$\mathcal{R}_{Ke3/K2\pi} = 0.2460 \pm 0.0015\,(\text{stat}) \pm 0.0006\,(\text{syst}) \quad [K^-]\,,$$
$$\mathcal{R}_{K\mu3/Ke3} = 0.6605 \pm 0.0040\,(\text{stat}) \pm 0.0017\,(\text{syst}) \quad [K^+]$$

and

$$\mathcal{R}_{K\mu3/Ke3} = 0.6661 \pm 0.0055\,(\text{stat}) \pm 0.0019\,(\text{syst}) \quad [K^-]\,.$$

The results for K^+ and K^- combined are

$$\mathcal{R}_{Ke3/K2\pi} = 0.2470 \pm 0.0009\,(\text{stat}) \pm 0.0004\,(\text{syst})$$

and

$$\mathcal{R}_{K\mu3/Ke3} = 0.663 \pm 0.003\,(\text{stat}) \pm 0.001\,(\text{syst})\,,$$

and they are shown in Figs. 8 and 9, respectively. The result for $\mathcal{R}_{K\mu3/K2\pi}$ remains unchanged [1].

Taking the current PDG value for the $K_{2\pi}$ branching fraction [2], the branching fraction for K_{e3} is found to be $\text{Br}\,(K_{e3}) = 0.05168 \pm 0.00019\,(\text{stat}) \pm 0.00008\,(\text{syst}) \pm 0.00030\,(\text{norm})$. Using this branching fraction and the input values listed in [1], the $|V_{us}|$ matrix element times the vector form factor $f_+(0)$ is found to be

$$\begin{aligned} |V_{us}|f_+(0) &= 0.2193 \pm 0.0012 \quad [K_{e3}] \qquad (1)\\ &= 0.21928 \pm 0.00039\,(\text{stat}) \pm 0.00017\,(\text{syst})\\ &\quad \pm 0.00062\,(\text{norm}) \pm 0.00096\,(\text{ext})\,. \end{aligned}$$

Combining this $|V_{us}|f_+(0)$ value for K_{e3} with the corresponding value for $K_{\mu3}$ in [1] and shown in Fig. 10, we

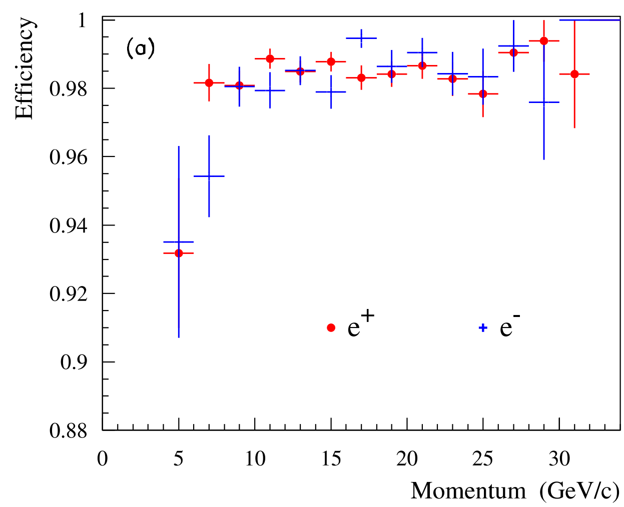

Fig. 4. a The E/pc particle identification efficiency for electrons from clean subsamples of K_{e3} decays

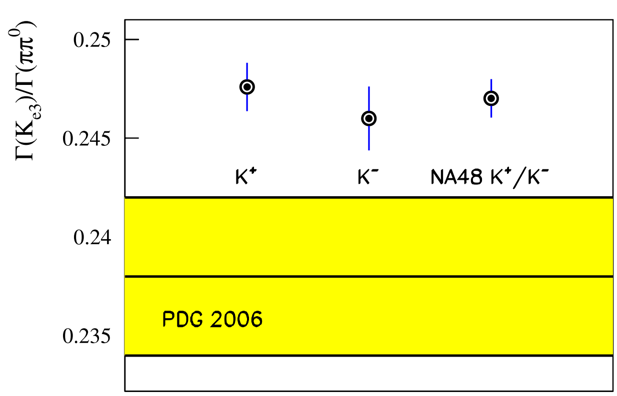

Fig. 8. $\mathcal{R}_{Ke3/K2\pi}$ result compared to the corresponding PDG value [2]. The $\mathcal{R}_{K\mu3/K2\pi}$ result is unchanged and shown in Fig. 8 of [1]

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Table 1. Updated information used to extract the branching ratio, where track $= e^{\pm}, \pi^{\pm}$ for $i = K^{\pm}_{e3}, K^{\pm}_{2\pi}$

Decay type	Raw number of events (N_i)	Acceptance × particle ID ($\mathrm{Acc}_i \times \epsilon_{\mathrm{trackID}}$)	Backgrounds/ signal (Δ_i)	Trigger efficiency (Trig_i)
K^+_{e3}	56.196	0.0698 ± 0.0001	$(0.0200 \pm 0.0008)\%$	0.9990 ± 0.0005
K^-_{e3}	30.898	0.0694 ± 0.0001	$(0.0209 \pm 0.0010)\%$	0.9982 ± 0.0008
$K^+_{2\pi}$	461.837	0.1418 ± 0.0001	$(0.2893 \pm 0.0058)\%$	0.9987 ± 0.0002
$K^-_{2\pi}$	256.619	0.1412 ± 0.0001	$(0.2896 \pm 0.0058)\%$	0.9990 ± 0.0002

Table 2. Recalculated percentage of expected background from Monte Carlo simulation for K_{e3} and $K_{2\pi}$ from the main contributors to their total background

Contributing channel	K^+	K^-
	K_{e3}	
$K_{\pi^\pm\pi^0\pi^0}$	$(0.0130 \pm 0.0007)\%$	$(0.0139 \pm 0.0009)\%$
$K_{2\pi}$	$(0.0070 \pm 0.0003)\%$	$(0.0071 \pm 0.0004)\%$
	$K_{2\pi}$	
$K_{\mu3}$	$(0.2848 \pm 0.0058)\%$	$(0.2846 \pm 0.0058)\%$
K_{e3}	$(0.0045 \pm 0.0006)\%$	$(0.0050 \pm 0.0008)\%$

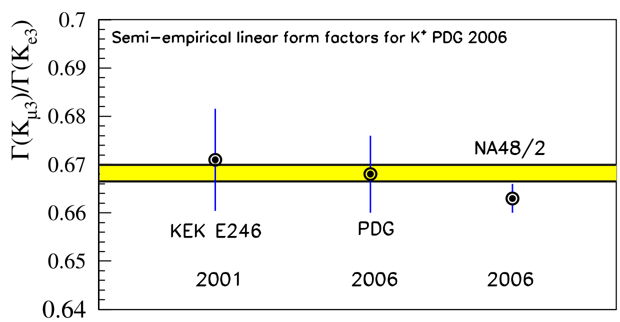

Fig. 9. $\mathcal{R}_{K\mu3/Ke3}$ results compared to KEK-246 results [4], the corresponding PDG value of 2006 [2] and to the predictions assuming μ–e universality, (6) in [1], with the λ_+ and λ_0 values given for $K^{\pm}$ in the PDG of 2006 [2]

obtain

$$|V_{us}|f_+(0) = 0.2188 \pm 0.0012\,, \qquad (2)$$

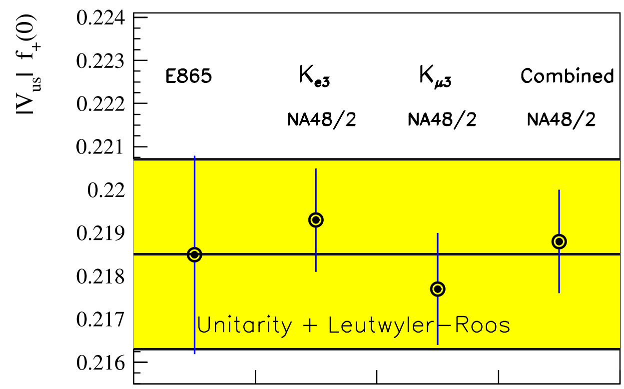

Fig. 10. Comparison of the NA48 measurement of $|V_{us}|f_+(0)$ from K_{e3} data in (1) and from $K_{\mu3}$ data in [1], and the K_{e3} BNL-E865 result [3]. The theoretical prediction shown is obtained assuming unitarity of the CKM matrix and using the values for V_{ud} and V_{ub} as input and the choice of $f_+(0)$ all as described in [1]

$$|V_{us}| = 0.2277 \pm 0.0013\,(\mathrm{other}) \pm 0.0019\,(\mathrm{theo})\,, \qquad (3)$$

which is consistent with the unitarity prediction as calculated in [1], namely, $|V_{us}|_{\mathrm{unitary}} = 0.2274 \pm 0.0013$.

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