

Measurements of Ke4 and $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ decays at NA48/2.

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Results are presented on $K^\pm \rightarrow \pi^+ \pi^- e^\pm \nu$ (Ke4) and $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ from the NA48/2 collaboration. The study of these two decay modes allows the extraction of $\pi\pi$ scattering lengths.

Keywords: Ke4, cusp, scattering length.

1. The $K^\pm \rightarrow \pi^+ \pi^- e^\pm \nu$ decay.

From a sub-set of the NA48/2 2003 data, about 370000 Ke4 decays have been analyzed. A fit of the data distributions of the Cabibbo-Maksymowicz¹ kinematic variables allows a precise measurement of the decay form factors^{2,3} F_s , F_p , G_p , H_p , which are expanded in powers of q^2 , and of $\delta = \delta_s - \delta_p$. Thanks to a sizeable acceptance at large $\pi\pi$ mass, a high sensitivity to the S-wave $\pi\pi$ scattering lengths a_0^0 and a_0^2 is achieved. Using the Universal Band⁴ constraint to fit the δ variation with $M_{\pi\pi}$ (Fig 1), the preliminary result for a_0^0 on the central line of the Band is:

$$a_0^0 = 0.256 \pm 0.008_{stat} \pm 0.007_{syst} \pm 0.018_{theory}$$

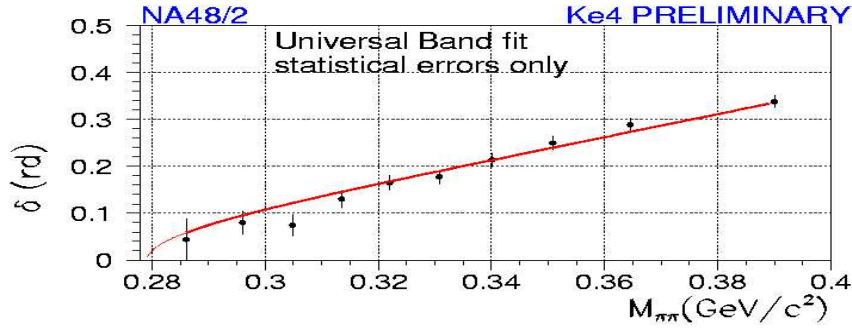
which corresponds to:

$$a_0^2 = -0.031 \pm 0.015_{stat} \pm 0.015_{syst} \pm 0.019_{theory}$$

The results for the q^2 variations of the relative form factors are summarized in Table 1.

2. The $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ decay.

A measurement of the scattering lengths has also been obtained through the interpretation⁵ of a cusp in the $\pi^0 \pi^0$ invariant mass (M_{00}) distribution of

Fig. 1. $M_{\pi\pi}$ dependence of the phase δ Table 1. Coefficients of form factors' q^2 expansions.

	Result	Statistical error	Systematic error
$f'_s/f_s =$	0.169	± 0.009	± 0.034
$f''_s/f_s =$	-0.091	± 0.009	± 0.031
$f'_p/f_s =$	-0.047	± 0.006	± 0.008
$g_p/f_s =$	0.891	± 0.019	± 0.020
$g'_p/f_s =$	0.111	± 0.031	± 0.032
$h_p/f_s =$	-0.411	± 0.027	± 0.038

the $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ decay. This anomaly was observed in the region around $M_{00}=2m_+$, where m_+ is the charged pion mass.⁶ The results are:

$$a_0^0 - a_0^2 = 0.268 \pm 0.010_{stat} \pm 0.04_{syst} \pm 0.13_{external}$$

$$a_0^2 = -0.041 \pm 0.022_{stat} \pm 0.014_{syst}$$

In addition, a non-zero quadratic term on the v variable has been found on the $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ Dalitz plot. The preliminary result is:

$$k' = 0.0097 \pm 0.0003_{stat} \pm 0.0008_{syst}$$

References

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