Experimental Study of the Matrix Element
in the $K^+ \rightarrow \pi^+ \pi^0 \pi^0$ Decay (*)

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Summary. — Two independent analyses of the decay mode $K^+ \rightarrow \pi^+ \pi^0 \pi^0$ ($\tau'$ mode) are presented; the first one only concerns the $\pi^+$ meson energy spectrum, while the second one is based on $\tau'$ decays for which the kinematics is completely determined. A linear description of the matrix element $M = 1 + a(M_{K^\pi} M_{\pi^0}^2) (2T^+ - T_{\text{max}}^+)$ is found to be satisfactory. The value found for $a$ is $-0.32 \pm 0.02$.

We present here two analyses of the decay mode $K^+ \rightarrow \pi^+ \pi^0 \pi^0$ based on a fraction of the material used in the $X2$-experiment (1) in which $5 \cdot 10^5 K^+$-mesons were stopped in the 1.2 m$^3$ CERN heavy-liquid bubble chamber filled with freon $C_2F_5Cl$. A total of 124 000 pictures, containing on the average 7 $K^+$-meson decays at rest, have been scanned using either procedure.

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1. - Experimental procedure.

1'1. Scanning criteria.

a) Analysis I (Brussels). The aim of this analysis is to determine only the $\pi^+$-meson energy spectrum. Therefore, the $\tau'$ decay candidates were selected in the following way:

the ionization of the $K^+$-meson track at the decay was consistent with that of a stopping $K^+$-meson,

the decays for which the $K^+$-meson scatters within the last centimeter were rejected,

the projected range of the charged secondary was less than 15 cm on the three views (the maximum $\pi^+$ range in a $\tau'$ decay is 10.5 cm in this experiment) and no interaction or scattering of more than 20° was observed along its track,

the secondary from the $K^+$ decay was identified as a pion, i.e. the complete $\pi^+-\nu-e$ decay chain was clearly visible.

Approximately 22000 pictures have been scanned twice by this method, the scanning efficiency being $(96 \pm 2)\%$. In order to avoid contamination by other decay modes (essentially $K^+ \to \pi^+\pi^0$ decays in flight) it was furthermore required that three or more $\gamma$-rays could be pointed back to the $K^+$-meson vertex. The final sample contains 1157 events.

b) Analysis II (Orsay and Paris). A more detailed analysis has been performed taking into account the measurements of the converted $\gamma$-rays. Events for which at least two converted $\gamma$-rays pointed back to the $K^+$-meson vertex were scanned for, independently of the $K^+$-meson decay mode. The $\tau'$ candidates had to satisfy the following conditions:

the range of the charged secondary was less than 10.5 cm,

three or more $\gamma$-rays were associated to the $K^+$ decay point,

conditions similar to the ones applied in analysis I were used to eliminate $K^+$-meson decays in flight and secondary $\pi^+$-meson interactions.

About 102 000 pictures have been scanned leading to a sample of 1700 events. A partial second scanning allows us to show that the scanning efficiency is independent of the $\pi^+$ and the $\pi^0$ energy. The efficiency $(66 \pm 2)\%$ takes into account the detection and correlation of $\gamma$-rays.

1'2. Measurement, geometrical reconstruction and kinematical analysis. – In analysis I, the measurement and reconstruction of the $\pi^+$ meson track do not