

## 75. Dalitz Plot Parameters for $K \rightarrow 3\pi$ Decays

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The Dalitz plot distribution for  $K^\pm \rightarrow \pi^\pm \pi^\pm \pi^\mp$ ,  $K^\pm \rightarrow \pi^0 \pi^0 \pi^\pm$ , and  $K_L^0 \rightarrow \pi^+ \pi^- \pi^0$  can be parameterized by a series expansion such as that introduced by Weinberg [1]. We use the form

$$\begin{aligned}
 |M|^2 &\propto 1 + g \frac{(s_3 - s_0)}{m_{\pi^+}^2} + h \left[ \frac{s_3 - s_0}{m_{\pi^+}^2} \right]^2 \\
 &+ j \frac{(s_2 - s_1)}{m_{\pi^+}^2} + k \left[ \frac{s_2 - s_1}{m_{\pi^+}^2} \right]^2 \\
 &+ f \frac{(s_2 - s_1)(s_3 - s_0)}{m_{\pi^+}^2 m_{\pi^+}^2} + \dots, \tag{75.1}
 \end{aligned}$$

where  $m_{\pi^+}^2$  has been introduced to make the coefficients  $g$ ,  $h$ ,  $j$ , and  $k$  dimensionless, and

$$s_i = (P_K - P_i)^2 = (m_K - m_i)^2 - 2m_K T_i, \quad i = 1, 2, 3,$$

$$s_0 = \frac{1}{3} \sum_i s_i = \frac{1}{3} (m_K^2 + m_1^2 + m_2^2 + m_3^2) .$$

Here the  $P_i$  are four-vectors,  $m_i$  and  $T_i$  are the mass and kinetic energy of the  $i^{\text{th}}$  pion, and the index 3 is used for the odd pion.

The coefficient  $g$  is a measure of the slope in the variable  $s_3$  (or  $T_3$ ) of the Dalitz plot, while  $h$  and  $k$  measure the quadratic dependence on  $s_3$  and  $(s_2 - s_1)$ , respectively. The coefficient  $j$  is related to the asymmetry of the plot and must be zero if  $CP$  invariance holds. Note also that if  $CP$  is good,  $g$ ,  $h$ , and  $k$  must be the same for  $K^+ \rightarrow \pi^+ \pi^+ \pi^-$  as for  $K^- \rightarrow \pi^- \pi^- \pi^+$ .

Since different experiments use different forms for  $|M|^2$ , in order to compare the experiments we have converted to  $g$ ,  $h$ ,  $j$ , and  $k$  whatever coefficients have been measured. Where such conversions have been done, the measured coefficient  $a_y$ ,  $a_t$ ,  $a_u$ , or  $a_v$  is given in the comment at the right. For definitions of these coefficients, details of this conversion, and discussion of the data, see the April 1982 version of this note [2].

### References:

1. S. Weinberg, Phys. Rev. Lett. **4**, 87 (1960).
2. Particle Data Group, Phys. Lett. **111B**, 69 (1982).