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FSI in $\eta \to 3\pi$ and the quark mass ratio Q^2

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To leading order the mass ratios of the three light quark flavours u, d, s are easily accessible and known for a long time. The next-to-leading order analysis has been performed by Gasser and Leutwyler [1]. They have shown that the quantity $Q^2 = \frac{m_s^2 - \hat{m}^2}{m_d^2 - m_u^2} = \frac{M_K^2}{M_\pi^2} \frac{M_K^2 - M_\pi^2}{M_{K^0}^2 - M_{K^+}^2} (1 + O(m^2))$ is given by the above ratio of pure QCD meson masses, up to corrections of *second* order. To use the experimental mass values for the mesons one has to correct for the e.m. mass contributions. This is highly controversial as Dashen's theorem may receive large corrections [2].

An independent way to measure Q^2 is provided by the isospin-violating decay $\eta \to 3\pi$ as the corresponding rate is proportional to Q^{-4} [3]. Sutherland's theorem proves to be stable [4] and the main uncertainties in obtaining a reliable rate come from the strong FSI of the π's. To evaluate those Kambor, Wiesendanger and Wyler [5] use extended Khuri-Treiman equations. The subtraction to the dispersion relation may then be fixed by the one-loop amplitude of Gasser and Leutwyler [3]. The FSI corrections are moderate and enhance the amplitude by 14% at the center of the Dalitz plot. This reduces the usual value for $Q^2 = 24.1$ obtained with Dashen to $Q^2 = 22.4 \pm 0.9$. In agreement with this result Anisovich and Leutwyler [6] have obtained $Q^2 = 22.7 \pm 0.8$ in their dispersive analysis.

References

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