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Determination of the m_u and m_d quark masses from eta->3pi decay

A natural method for the precise determination of the $m_d - m_u$ mass difference, which is still beyond the reach of direct lattice simulations, is a comparison of a measured value of some quark-mass dependent observable with its chiral perturbation theory prediction. The most promising processes for such study seem to be eta->3pi decays. Unfortunately, achieving this goal is complicated by large chiral corrections to the amplitudes of these processes and by the observed discrepancies between the experimentally measured values of Dalitz parameters describing their energy dependencies and the values predicted from chiral perturbation theory.

We present a method based on our analytic dispersive representation which uses the information we have from the two-loop chiral result together with the one obtained from the KLOE measurement on the charged eta->3pi decay in the consistent way, thereby determining the value of the quark mass ratio 1/R~(m_d-m_u). Our result is R=37.7\pm2.2. Using the recent lattice values for m_s and the isospin averaged value of (m_u + m_d)/2, our determination leads to m_u(2GeV)=(2.2\pm0.6) MeV and m_d(2GeV)=(4.6\pm0.6) MeV. Provided there is available a better access to the energy dependence of the (charged) eta->3pi amplitude, this result can be still substantially improved.

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