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Dalitz-plot analysis of the $D^0 \to K_S^0 \pi^+ \pi^-$ decays in a factorization approach

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Collaboration

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Abstract content

A quasi two-body QCD factorization is used to study the $D^0 \to K_S^0 \pi^+ \pi^-$ decay channel. Starting from the weak effective Hamiltonian, 28 tree and annihilation (W-exchange) amplitudes build up the full $D^0 \to K_S^0 \pi^+ \pi^-$ amplitude [1]. The meson-meson final state interactions are described by the kaon-pion and pion scalar and vector form factors for the S and P waves and by Breit-Wigner formulae for the D waves. Unitarity, analyticity and chiral symmetry are used to constrain functional forms of form factors and to group several resonances in a given partial wave. This, together with charge symmetry, allows to reduce the 27 non-zero amplitudes into 10 effective amplitudes depending on 33 free parameters. The presently available high-statistics Dalitz plot data of the $D^0 \to K_S^0 \pi^+ \pi^-$ process measured by the Belle and BABAR Collaborations are analyzed together with the $\tau^- \to K_S^0 \pi^- \nu_\tau$ decay data. The total experimental branching fraction is also included in the fit which shows a very good overall agreement with the Dalitz plot density distribution. The branching fractions of the dominant channels compare well with those of the isobar Belle or BABAR models. We show that the lower-limit values of the branching fractions of the annihilation amplitudes are significant. Our $D^0 \to K_S^0 \pi^+ \pi^-$ decay amplitude could be a useful input for determinations of $D^0 - \bar{D}^0$ mixing parameters and of the Cabibbo-Kobayashi-Maskawa angle gamma (or phi3). Upon request, we can provide numerical values for our amplitudes.

[1] J.-P. Dedonder, R. Kaminski, L. Lesniak and B. Loiseau, arXiv:1403.2971 [hep-ph].

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