The Study of $\Sigma\pi$ Invariant Mass Spectrum of the In-flight Kaon Interaction on the Deuteron Target

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Abstract

In this article, using the coupled-channel procedure, $\Sigma\pi$ invariant mass spectra ($M_{\Sigma\pi}$) of the in-flight kaon interaction on the deuteron target is investigated. In the calculation of the interaction cross-section, two processes as the one- and two-interaction processes are considered. The one-interaction process dominates at low values momenta of the incident kaon ($P_{\text{Lab}} < 400\text{ MeV/c}$) whereas the two-interaction contribution is not negligible at high values ($P_{\text{Lab}} \approx \text{GeV/c}$) and both processes should be considered in the total cross-section amplitude. By using $\chi^2$ analysis and considering the $\Sigma^* (1385)$ population, the $\pi N$ sub-threshold theoretical invariant mass spectra are fitted to Braun’s data that the mass and width of $\Lambda (1405)$ are respectively extracted as $M = 1432\text{MeV/c}^2$ and $\Gamma = 20\text{MeV}$. Although the present result is in fairly good agreement with the results of the chiral SU(3) models, it is not consistent with the current value of the Particle Data Group.

Keywords: $\Lambda (1405)$, $K^- - d$ interaction, kaonic nuclei

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