Determination of the $\mathcal{N} \Lambda K$ Coupling Constant
Weakly Dependent on the Unphysical-Region Parametrization.

M. RESTIGNOLI and G. VIOLINI (*)

Istituto di Fisica dell'Università - Roma

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Summary. Using a dispersion relation for a function related to the $K^\pm N'$ scattering amplitude it is possible to make the value of the $\mathcal{N} \Lambda K$ coupling constant depend weakly on the parametrization used for the $K\Lambda N'$ unphysical region. The numerical application of the method confirms the violation of the $SU_3$ symmetry for the $\mathcal{N} \Lambda K$ coupling constants.

1. - Introduction.

In recent years forward dispersion relations have been widely applied to the study of $K N$ scattering (1). Perhaps the main problem which has been considered is that of determining the values of the $\mathcal{N} \Lambda K$ coupling constants (\textsuperscript{**}). The interest in this comes also from the fact that $SU_3$ symmetry provides definite predictions (2) for $g_{\mathcal{N} \Lambda K}^2$ and $g_{\Sigma \Lambda K}^2$. No special complications are present when the same problem is examined in the case of $\Sigma N$ scattering and in fact $g_{\Sigma N \pi}^2$ is fairly well known (3). However in $K N'$ scattering one has to estimate the contribution from the dispersion integral in the unphysical region below the $K N'$ threshold.

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(\textsuperscript{**}) In the following we shall use the notation $g_{\mathcal{B} \mathcal{B} \mathcal{P}}^2$ for the baryon-baryon-pseudoscalar meson coupling constant. The normalization is such that $g_{\Sigma N \pi}^2 = 14.5$. For a discussion of earlier work, see Sect. 3 of ref. (4).


The main source of ambiguity in the determination of $g^2_{\pi\Lambda K}$ is that in the $I=0$ $\bar{K}N'$ channel there exists a resonance, the $Y^*_0(1405)$, whose contribution turns out to be quite important. In principle this contribution could be evaluated by extrapolating below threshold the low-energy $\bar{K}N'$ phase-shift analyses, since all of them exhibit a resonant behaviour at the right position with a reasonable width (*).

The earliest determinations suggested a violation of $SU_3$ (4); this is in agreement with results from photoproduction and associated production (5). However it was soon realized (*) that $g^2_{\pi\Lambda K}$ is very sensitive to the model used to parametrize the low-energy $\bar{K}N'$ scattering amplitude. There are several models proposed in the literature, namely a constant scattering length (CSL) (7), an effective range (ER) (6) and a zero range (ZR) (9) $K$-matrix parametrization for the $\bar{K}N'$ amplitude.

Roughly speaking CSL and ZR are inconsistent with $SU_3$ and predict for $g^2_{\pi\Lambda K}$ quite small values; whereas using ER the value of $g^2_{\pi\Lambda K}$ is found to be in agreement with that required by the symmetry.

The sensitiveness of the $g^2_{\pi\Lambda K}$ value to the kind of parametrization used made it clear that one has to find some criterion to choose between these models. Recently it was proposed to check whether the low-energy parameters satisfy the consistency test imposed by dispersion relations. This technique allowed one to rule out the ER solution (10).

Thus the value of $g^2_{\pi\Lambda K}$ predicted by CSL and ZR is consistent with dispersion relations; nevertheless it is clear that it would be necessary to find a method which on one hand definitely reduces the model dependence of the result and on the other depends mainly on physically accessible quantities.

The purpose of this work is just to present such a method and to calculate again the value of $g^2_{\pi\Lambda K}$ in a way which strongly reduces the dependence on the model for the unphysical region. We shall also discuss which kind of

(*) Actually the presence of $Y^*_0$ is usually required in order to discard some solutions, among those which fit the experimental data.


