INELASTIC EFFECTS ON THE πNN VERTEX FUNCTION†

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The πNN vertex function with one nucleon off-mass shell was previously obtained from experimental data through sideways dispersion relations. The πNN form factor K(W), the nucleon dressed propagator $S'_F(W)$ and the proper vertex function $\Gamma(W)$, as defined in ref. 1, are real analytic functions, with cuts along $|W| \geq m_N + \mu_\pi$. This analytic structure and the discontinuity

$$\text{Im } K(W) = f^{*}_{\pi N}(W)\ K(W) + \sigma(W) \tag{1}$$

are first exploited to find K(W). In eq. (1), $f_{\pi N}(W)$ represents the π-N scattering amplitude in the P_{11} wave [S_{11} wave] when one has : $W > m_N + \mu_\pi$ [$W < -(m_N + \mu_\pi)$ respectively] and the second term $\sigma(W)$ which is different from zero for $|W| \geq m_\pi + 2\mu_\pi$, corresponds to inelastic contributions from higher mass (multiparticle) intermediate states. As is well known[2], the complete knowledge of σ overdetermines K ; it is sufficient to know the phase $\eta(W)$ of $\sigma(W)$ in order to get the solution K(W) of eq. (1). In ref. 3, the function K(W) was calculated with $\gamma = \pi/2$ whereas in ref. 1, the πNN proper and improper vertex function as well as the dressed nucleon propagator were computed with the choice $\gamma = 0$. In the present calculation, the phase γ is taken as a parameter and we test the sensitivity of the results with respect to the inelasticities. From its analytic structure, we easily see that $S'_F(W)$ can have at most two zeros $W_\pm$ ($-m_N - \mu_\pi \leq W_- < m_N < W_+ \leq m_N + \mu_\pi$) ; clearly, the proper vertex function $\Gamma(W)$ and the irreducible πN amplitude acquire ghost poles at these zeros. Our present calculations show that the pole W_- is well established and rather insensitive to γ whereas the pole W_+ is very sensitive to the inelasticities. For the existence of the pole at W_+ we can say nothing definite at present (W_+ disappears for $\gamma > .3$) although a generalized Lee model[4] supports its existence. These ghost poles of the irreducible πN amplitude have a possible influence upon some pion-nucleus amplitudes[1,5]. Indeed, in order to avoid overcounting of pionic interactions already accounted for in the dynamics of nuclear bound states as well as in the initial and final distorted waves, an effective pion nucleon scattering amplitude is to be used instead of the complete amplitude. This effective amplitude corresponds to the irreducible amplitude, the pole of which may have important effects under certain kinematical conditions. The irreducible amplitude which is unitary together with the total amplitude has also been computed ; its phase is rather sensitive to the value of γ, so that a model for inelastic contributions is needed.

† This work was supported by the Institut Interuniversitaire des Sciences Nucléaires, Belgium.

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International Conference on Nuclear Physics, Berkeley, California, August 24-30, 1980.

Presented by P. Rochus