Comment on “πNN Coupling from High Precision np Charge Exchange at 162 MeV”


In a recent letter [1], a measurement of the np differential cross section in the backward direction at a single energy $T_{lab} = 162$ MeV was reported. These 31 data were then used to extract for the charged pion-nucleon coupling constant the value $f^2 = 0.0808$, with an extrapolation error of 0.0003 and a normalization error of 0.0017.

We make the observation that this coupling constant has been determined in recent years by several groups in various energy-dependent partial wave analyses (PWA) which give very good fits to various energy-dependent partial wave analyses (PWA) have been determined in recent years by several groups in which result in a total error of 0.

The backward np differential cross section is sensitive to $f^2$. That is therefore a good place to determine this coupling constant is a widespread misunderstanding. This has been shown [8] in an energy-dependent PWA of the np data. The backward np data do not show any particular sensitivity to $f^2$. In table V of [8] one can see that in our energy-dependent PWA using all np scattering data and all types of observables, $f^2$ shows no special sensitivity to any particular type of observable.

In the same paper it has been shown, using physical extrapolation techniques, that analyzing backward np data at a single energy, as in Ref. [1], gives values of $f^2$ with a large spread which result in a total error of 0.003, which is 10 times larger than the extrapolation error claimed in [1]. This was confirmed by Arndt et al. [9], who used exactly the same techniques as used in [1] for all the available backward data, and not for only one dataset as was done in [1]. Their values for $f^2$ as determined at a single energy vary from 0.061 to 0.091 with an average of 0.075 and an error of 0.009, which is 30 times the extrapolation error quoted in [1].

The extrapolation method of Ericson et al. relies heavily on the absolute normalization of the data. Normalizing np cross sections is very difficult. In their determination of $f^2$ it is another important source of uncertainty. In energy-dependent PWA’s, however, as in [2], one does not need normalized data to determine the coupling constant; one can use the shapes of the measured differential cross sections.

The authors have applied their method for extraction of $f^2$ to data which cannot be described satisfactorily by either the Nijmegen PWA [2] or the VZ40 PWA of Arndt et al. [4]. The Nijmegen PWA gives, after refitting, $\chi^2 = 264.0$ for these 31 data points and the VPI&SU PWA gives $\chi^2 = 236.7$. One reason for the bad fit can be seen in the large discrepancy between the shape of the newly reported data and the shape of the older data of Bonner et al. [10] at exactly the same energy. The authors should have reported $f^2$ from applying their extrapolation method to the Bonner data and compared the results. However, the new data disagree not only with the Bonner data, they disagree with the whole Nijmegen np data set, consisting of circa 3900 data below 500 MeV. They disagree because their shape is more than 25 standard deviations (sd) away from both the Nijmegen and VPI&SU databases. Such a shape we consider, for statistical reasons, to be wrong.

Our conclusions are as follows: (i) The experimental data as presented are statistically flawed (more than 25 sd). This is at least partially caused by the way these data are normalized. Similar data [11] at 96 MeV from the same group are not included in the Nijmegen database [2] because they also disagree significantly with the total dataset. (ii) Achieving an accurate determination of $f^2$ from the backward np data at one single energy is a rather unrealistic exercise. To determine $f^2$ accurately, we have shown that the energy-dependent PWA’s are superior.

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