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

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In a recent letter [1], a measurement of the np differential cross section in the backward direction at a single energy $T_{\rm lab}$ = 162 MeV was reported. These 31 data were then used to extract for the charged pion-nucleon coupling constant the value $f_c^2 = 0.0808$, 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 *several thousands* of np [2–4], πN [5,6], and $\overline{p}p$ charge-exchange [7] scattering data. The values of f_c^2 determined in these different PWA's are in excellent agreement. A representative value (with error) for this coupling constant is $f_c^2 = 0.0748(3)$ [8].

The backward np differential cross section is sensitive to f_c^2. That it 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_c^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_c^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_c^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_c^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_c^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_c^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_c^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_c^2 from the backward np data at one single energy is a rather unrealistic exercise. To determine f_c^2 accurately, we have shown that the energy-dependent PWA's are superior.

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