Comments

Comments are short papers which comment on papers of other authors previously published in **Physical Review C**. *Each Comment should state clearly to which paper it refers and must be accompanied by a brief abstract and keyword abstract.*

Comment on "Proton-^{4}He elastic scattering at intermediate energies"

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This comment refers to the proton-^{4}He elastic scattering differential cross section data in the energy range scanned by G. A. Moss *et al.* A comparison is made between the Moss *et al.* results and older results in the energy range $T_p = 0.1-0.65$ GeV. There is a short discussion about the concept of intermediate energies in the reaction considered here.

[NUCLEAR REACTIONS ^{4}He$(p,p)^4$He, $E = 0.2-0.5$ GeV; compared $\sigma(E,\theta)$ with other results at $E = 0.1-0.65$ GeV; discussed intermediate energy range concept.]

Our main point in this Comment is that, in their paper,[1] Moss *et al.* do not present or refer to data that exist for energies near those of their own energies. In consequence, an understanding of energy dependence, which would be valuable, is not possible.

Our second point is to demonstrate that the energy dependence of proton-^{4}He elastic scattering shows a very smooth transition in the shape of the differential cross sections from 0.1 to 5 GeV. We propose therefore that the "intermediate energy range" be defined to extend at least between these limits, for both forward and backward scattering.

Figure 1 presents a compilation of the proton-^{4}He elastic scattering differential cross sections, including the results of Moss *et al.*[1] We have selected data for comparison according to the following criteria. (1) Data are shown at incident energies not too far above or below those of Refs. 1 and 2. (2) For $T_p < 0.5$ GeV, the data presented are from experiments where measurements extend to 180° in the center of mass system.[3] (3) For $T_p > 0.5$ GeV, the data considered cover the highest values of t presented by Moss *et al.* (Fig. 1).

We note that the data of Moss *et al.* (plotted in Fig. 1) include previously obtained results of the same group [forward scattering (Ref. 2); backward scattering (Ref. 3)]. We have plotted data of Comparat *et al.*[4] at $T_p = 156$ MeV, as well as backward scattering data at $T_p = 298$ and 438 MeV (Ref. 5) and $T_p = 438$ and 648 MeV (Ref. 6).

In their comparisons with existing data, Moss *et al.* have made several omissions.

(1) Their 200 MeV data are similar to the 156

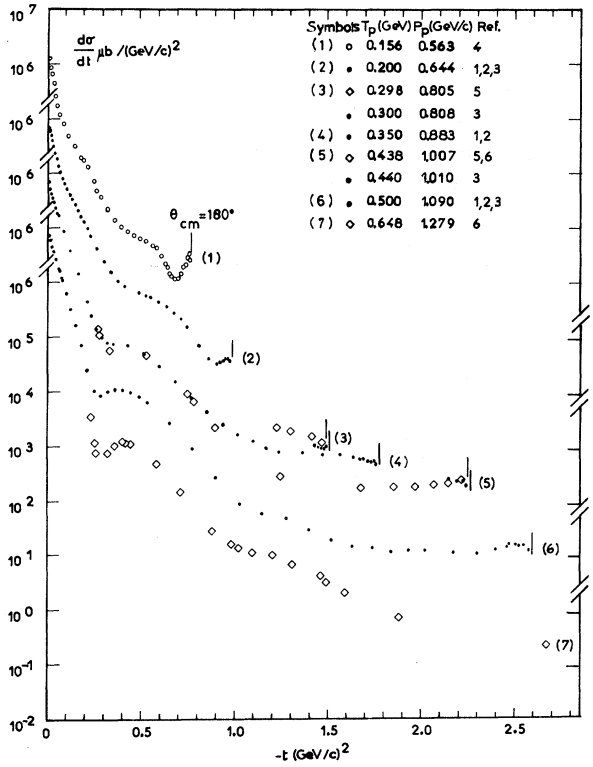

FIG. 1. Proton-^{4}He elastic scattering differential cross section as a function of the four-momentum transfer squared. The symbols refer to data sets obtained by different series of experiments: Refs. 1, 2, and 3 (●), Ref. 4 (○), Ref. 5 and 6 (□). The curves are labeled in order of increasing energy from (1) to (7); the same label is used for neighboring energies. The vertical lines show the transfer t at $\theta_{c.m.} = 180°$.

MeV data of Comparat *et al.*[4] (Fig. 1). There is no reference to these data in their paper. Reference is made, however, to unpublished work of Gotow at 203 MeV (Ref. 7), but these measurements do not cover $\theta_{c.m.} > 90°$.

(2) A structure appearing in their data in the region of $t \sim -1$ (GeV/c)^2 is commented on in connection with the Glauber model calculation.[1] We point out that this structure has previously been noted at 438 and 648 MeV (Ref. 6).

(3) For backward angles, the situation is similar; their data fall nicely between those of Ref. 5, which they do not refer to, and those of McCamis *et al.*[3]

In their discussion[1] about the need for measurements at 275, 425, and above 600 MeV, they do not refer to extant, though "not complete," data at 298, 438, and 648 MeV (Refs. 5 and 6).

At 788 MeV, there also exists a complete angular distribution.[8] Furthermore, a sharp backward peak has already been observed at $T_p = 1.05$ GeV (Refs. 6 and 9).

To consider our second point, Fig. 1 shows smooth energy behavior for the proton-^{4}He elastic differential cross section at small t (forward angles). This behavior is consistent when higher energy data (up to about $T = 5$ GeV) are added to the comparison [see data of Nasser *et al.* at $T_p = 2.68$ GeV (Ref. 10) and $T_p = 4.89$ GeV (Ref. 11)]. This illustrates our proposal that the "intermediate energy range" be defined between $T_p \sim 0.1$ and 5 GeV.

For backward angles the situation is more complex, as is readily shown by the data at 298, 438, 648, and 840 MeV (Ref. 5) and at 1.05 GeV (Ref. 9). In the latter, these data are compared with data obtained at very low energies (a few MeV) and with predictions based on the triton-exchange mechanism.[9] The "intermediate energy range" therefore appears to merge continuously into the low energy region, which suggests that, for backward angles, it is difficult to define an energy as being "intermediate."

To summarize, we have drawn attention to the importance of considering the complete body of data on proton-^{4}He scattering that exists at intermediate energies in order to arrive at the fullest understanding of the very beautiful data of Moss *et al.* Without this consideration, there may result for the reader an incomplete picture of the state of knowledge of proton-^{4}He scattering at intermediate energies.

[1]G. A. Moss *et al.*, Phys. Rev. C 21, 1932 (1980).
[2]A. W. Stetz *et al.*, Nucl. Phys. A290, 285 (1977).
[3]R. H. McCamis *et al.*, Nucl. Phys. A302, 388 (1978).
[4]V. Comparat *et al.*, Phys. Rev. C 12, 251 (1975).
[5]J. Berger *et al.*, Phys. Lett. 63B, 111 (1976).
[6]J. Berger *et al.*, Phys. Rev. Lett. 37, 1195 (1976).
[7]K. Gotow, University of Rochester, Report No. NYO-2532, 1959 (unpublished).
[8]J. Fong *et al.*, Phys. Lett. 78B, 205 (1978).
[9]J. Berger *et al.*, Phys. Rev. Lett. 41, 152 (1978).
[10]M. A. Nasser *et al.*, Nucl. Phys. A312, 209 (1978).
[11]M. A. Nasser *et al.*, Phys. Rev. C 17, 1748 (1978).

Response to Comment

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A response to the Comment on proton-^{4}He elastic scattering at intermediate energies is presented.

Goldzahl and Plouin[1] comment on the lack of a complete list of references relating to published data near the energies reported in our paper. Since our publication was not intended to review the entire field of proton-^{4}He elastic scattering, our new data were compared only to the most recent existing data at the nearest relevant energy. Our earlier papers,[2] which dealt directly with the large- and small-angle scattering regimes, contained further references to extant, relevant data, including that of Goldzahl.

The choice of the title of our paper, made with brevity and conciseness in mind, was perhaps more inclusive than it should have been. However, a reading of the abstract leaves no ambiguity regarding the paper's intended goals.

[1]L. Goldzahl and F. Plouin, Phys. Rev. C 26, 744 (1982) (preceding Comment).
[2]R. H. McCamis *et al.*, Nucl. Phys. A302, 388 (1978) and references therein; J. M. Cameron *et al.*, Phys. Lett. 74B, 31 (1978), and references therein.