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.*

Role of pion absorption on quasi-deuterons in $^{12}C(\pi^+, 2p)$

D. Ashery
Department of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Israel
(Received 13 November 1984)

It is argued that the conclusions drawn from recent distorted-wave impulse approximation calculations of the $^{12}C(\pi^+, 2p)$ reaction should be based on results of calculations which include distortions. Such results support the interpretation given in the paper describing the experimental study of this reaction.

Recently, Ritchie *et al.*[1] performed distorted-wave impulse approximation (DWIA) calculations for the $^{12}C(\pi^+, 2p)^{10}B$ reaction, to be compared with the experimental study of this reaction by Altman *et al.*[2] When the calculations are performed using plane waves for both the incoming pion and the outgoing protons, the authors obtain good agreement with the measured p-p angular correlation, including a part that was considered as background in the analysis of Ref. 2. The authors conclude that part of this background should not have been subtracted, as it represents a direct quasi-deuteron absorption. As a consequence, the direct quasi-deuteron absorption cross section should be larger than the value deduced in Ref. 2. The authors justify the use of plane waves by referring to Eisenberg and Koltun,[3] who suggest that under certain circumstances it may be allowable or appropriate to use plane waves in calculations of pion absorption.

In the present Comment I want to raise two objections to the results of these calculations and to the conclusion drawn by the authors of Ref. 1. First, the circumstances under which Eisenberg and Koltun suggest the use of plane waves are not met by the experimental conditions involved here. The use of plane waves is considered adequate for calculations of inclusive cross sections such as total absorption or angle-integrated cross sections. It is argued that pions may be absorbed after scattering, and that it is therefore incorrect to remove them from the absorbed-pion flux. It is separately suggested that distortions may be negligible for very low energy pions, even in exclusive cases, but definitely must be considered in the delta-resonance region. The experimental conditions of Ref. 2 impose severe restrictions on the kinematic variables of the outgoing protons, so that if they were generated after pion scattering they will be deflected and not included in the quasi-deuteron peak. Similarly, protons that underwent major final-state interaction will also be deflected and not counted. This experiment is, therefore, far from being inclusive, and calculations which include distortion of both incoming pion and outgoing protons are more appropriate. The bombarding energies used in the experiment, namely, 165 and 245 MeV, are certainly not low as required by Eisenberg and Koltun to justify plane wave calculations in the incoming channel for a nearly exclusive situation.

The second objection refers to the parameter r_d, the radius of the Woods-Saxon potential which binds the absorbing deuteron to the ^{10}B core. The shape of the calculated angular correlation is very sensitive to this parameter. In particular, the contribution to the part of the angular correlation which was considered as background in Ref. 2, increases significantly with increased value of r_d, as can be seen from Fig. 4 of Ref. 1. The value of r_d used in the calculations is too large, as it yields a wave function having an rms radius of 3.00 fm rather than 2.45 fm as deduced from electron scattering.[4] A value consistent with electron scattering results will, therefore, yield a smaller contribution to this part of the angular correlation.

When distortions are introduced into the calculations, as the authors note, the calculated angular correlation becomes narrower. The calculated shape now resembles that of the narrow Gaussian peak taken by Altman *et al.* as the quasi-deuteron absorption component. There is no significant contribution in the region considered as background. This agreement will become even better when smaller r_d values are used in the calculations. When these calculations are compared with the experimental results they in fact support the interpretation given in Ref. 2. The reduction in absolute magnitude caused by the distortions is expected, but the disagreement with the data in the absolute values may be attributed to various components of the calculations. For example, the authors neglect absorption on *s*-shell nucleons even when using plane wave calculations. This disagreement cannot, therefore, be a reason to favor the results based on plane wave calculations. The conclusion that should be drawn from the paper by Ritchie *et al.*[1] should be based on the calculations made with distortions included, and these are in agreement with the analysis done by Altman *et al.*[2] Consequently, the fraction of the total absorption cross section observed in the $^{12}C(\pi^+, 2p)$ reaction, unperturbed by initial or final state interactions, is still only about 10%.

[1]B. G. Ritchie *et al.*, Phys. Rev. C **30**, 969 (1984).
[2]A. Altman *et al.*, Phys. Rev. Lett. **50**, 1187 (1983).
[3]J. M. Eisenberg and D. S. Koltun, *Theory of Meson Interaction with Nuclei* (Wiley, New York, 1980), p. 314ff.
[4]C. W. DeJager *et al.*, At. Data Nucl. Data Tables **14**, 479 (1974).

