## PION DEUTERON ELASTIC SCATTERING\*

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In the present work we perform an extensive analysis of the existing experimental<sup>1</sup> data on pion-deuteron elastic scattering at low energies, in the framework of the multiple scattering series. We evaluate the single scattering and the double scattering terms, accounting for nucleon recoil and fermimotion effects. The effects of the kinematical ambiguities in the use of the two-body  $\pi N$  amplitudes are studied. These ambiguities become more important when fermi-motion is taken into account, different choices of values of the effective meson nucleon colliding energy leading to predictions for the differential cross sections which are sometimes largely discrepant. We have used three different prescriptions (called A, B, C) for the resolution of these ambiguities.

A) The energy for the  $\pi N$  collision is determined by Faddeev equation.<sup>2</sup> If s is the center-of-mass kinetic energy for the  $\pi d$  system, and p is the nucleon momentum inside the deuteron, then the kinetic energy used in the  $\pi N$  center of mass when calling the  $\pi N$  amplitude is given by  $s-p^2/2\mu$ , where  $1/\mu = 1/m_N + 1/(m_N + m_\pi)$ .

B) The incident meson and the interacting nucleon are on the mass shell, with the physical values for their masses.

C) The spectator nucleon is on the mass shell, with kinetic energy  $p^2/2m_{N^{\circ}}$  The interacting nucleon is off the mass shell, with momentum p, and energy given by the deuteron mass minus the spectator total energy.

To our knowledge, in the present work for the first time a calculation of the multiple scattering series is performed according to prescription A, which seems to be better founded theoretically. We are glad to note that the results obtained in case A give a much improved description of the data.

In the figures below we compare results obtained with different kinematical prescriptions. The solid curve in the figures refers to prescription A, while the dotted lines refer to B, and the broken line in Fig. 1 is obtained in case C.

Fermi-motion effects, which have been taken into account in all curves presented, improve substantially the description of the experimental results.

We see that the use of kinematical relations defined by the Faddeev equations brings a remarkable improvement to the multiple scattering calculation in the middle energy region.

At the higher energies and for large scattering angles, the Faddeev kinematics leads to values of the differential cross section which are small as compared to the data. The reasons for the discrepancy may perhaps be found in the deuteron structure, and changes in the large momentum tail of the wave function could improve the fitting.

At lower energies, as at 47.5 MeV, Faddeev kinematics <u>including fermi</u> motion effects predicts values for the differential cross section which are too low as compared to the data. The discrepancies may be due to the use of an inadequate set of phase-shifts, or to bad off-mass-shell extrapolations.

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## REFERENCES

- Experimental data: 47.5 MeV, 1. D. Axen at al., Nucl. Phys. A 256, 387 (1976); 85 MeV, K.C. Rogers et al., Phys. Rev. 105, 247 (1957); 142 MeV, E. G. Pewitt et al., Phys. Rev. 131, 1826 (1963); 182 MeV, J. H. Norem, Nucl. Phys. B 33, 512 (1971); 224 MeV. J. L. Acioli, Ph.D. thesis, Chicago University (1968); 256 MeV, K. Gabathuler et al., Nucl. Phys. B 55, 397 (1973); 234.4 MeV and 324.9 MeV, Preliminary Data, Los Alamos Report LA-6156-R; 375.7, 412.4, and 469.6 MeV, L. S. Schroeder et al., Phys. Rev. Lett. 27, 1813 (1971).
- 2. A. E. Thomas, Proc. Int. Conf. on Few Body Problems in Nuclear and Particle Physics, Laval U., Quebec, 27-31 Aug 1974, p. 287.





Figs. 1,2,3. Results of multiple scattering calculations using different prescriptions for the kinematics in  $\pi N$  collision. The solid lines show results for kinematics specified by Faddeev equation. For experimental points, see Ref.1.