$$\frac{\xi}{\delta}\,\frac{H_{c3}}{\Delta}\,\frac{\partial\Delta}{\partial H}$$

and can be appreciable, in spite of the small factor ξ/δ in this approximation, because $\partial\Delta/\partial H$ is large. Such an anisotropy was observed experimentally in [7].

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PION-DEUTERON AND PION-NUCLEON SCATTERING LENGTHS

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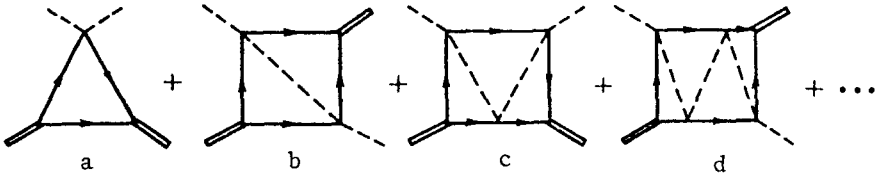
1. Pion-deuteron scattering at low energies is of interest from two points of view. First, this is the simplest process of pion interaction with nuclei, and its use as an example makes it easiest to verify the accuracy of the a-sumptions customarily made upon introduction of the Kisslinger-Ericson potential or in other theoretical schemes. Second, one can hope that measurement of the pion-deuteron scattering length can yield additional information on the parameter b_0, which is the average of the π^-n and π^-p scattering lengths and is presently known with very poor accuracy, although it is of interest in a number of theories (e.g., in the PCAC hypothesis its value is rigorously equal to zero).



The πd-scattering amplitude was obtained in [1] by summing a series of diagrams (see the figure), and the expression used for the πN scattering was

$$f_{\pi N} = b_0 + b_1 \vec{t}\cdot\vec{\tau}, \qquad (1)$$

where $\vec{t}$ and $\vec{\tau}$ are the pion and nucleon isospin operators. The main contribution is made by single- and multiple-scattering terms, in which the p-wave part of the πN interaction was also taken into account, and in the double-scattering term allowance was made also for effects connected with the kinetic energy of the nucleons in the intermediate state. The numerical values of the parameters b_0 and b_1 were taken from the review [2]: $b_0 = -0.017 \pm 0.006$ F and $b_1 = -0.097 \pm 0.007$ F. As shown in [3], the contribution of the diagrams with virtual rescattering of the nucleons can be neglected.

A group at the University of London has recently performed an exact measurement of the energy of the 2p - 1s transition in a pionic deuterium atom, and obtained a preliminary result for the πd-scattering length

$$a_{\pi d} = -0.083 \pm 0.021 \text{ F}. \quad (2)$$

In view of the publication of experimental information, we have refined a number of items in the calculation of the d-scattering length, namely, a more accurate calculation of the contribution of scatterings with multiplicity larger than tw, allowance for the energy released in the charge-exchange process $\pi^- p \to \pi^0 n$, and a calculation with a more realistic deuteron function, the so-called third Moravcsik function.

2. Calculations with formula (A.8) of [1] show that the contribution of the higher-multiplicity scattering is quite sensitive to the behavior of the deuteron wave function at short distances, and amounts to 0.006 F for the Hulthen function and 0.003 for the third Moravcsik function.

3. Approximately half the contribution of the double scattering (diagram b) is connected with the virtual charge exchange $\pi^- p \to \pi^0 n$, in which an energy Q = 3.3 MeV is released. This energy release was not taken into account in [1], where an isotopic-invariance formalism was used. When this release is taken into account, ε_d in the denominator of formula (5) of [1] is replaced by $\varepsilon_d - Q = -1.1$ MeV. The amplitude therefore acquires an imaginary part, but a very small one (0.0004 F). In addition, the factor $(1 + \alpha^2)$ of [1], which determines the ratio of the double-scattering term calculated with formula (A.8) to its real value obtained by taking into account the nonadiabatic terms in the pion propagator becomes equal to 1.21 in lieu of 1.37. This changes the over-all result by adding -0.002 F to it.

4. Owing to a numerical error, [1] cites an incorrect value -0.29 (see formula (40)) for the ratio of the contributions of the s-wave and p-wave parts in the double-scattering term (in the estimate of the combination $(b_0c_0 - 2b_1c_1)$ the figure used for b_0 was taken from the review [2], where it is given with the wrong sign). The correct values is 0.25. This is taken into account in the figures given below.

5. Taking all the considered corrections into account, we find that the $\bar{}$d-scattering length for the Hulthen function is

$$a_{\pi d} = -0.061 \text{ F}, \quad (3)$$

and for the third Moravcsik function

$$a_{\pi d} = -0.057 \text{ F}. \quad (4)$$

The proposed method enables us to calculate the non-absorptive part of the scattering length within several per cent. The real accuracy, however, is low because of the uncertainty in the information on the s-wave πN scattering lengths. If we estimate the error on the basis of the errors in the employed πN-interaction parameters, we obtain ± 0.016 F.

All the presented figures pertain to the nonabsorptive part of the scattering length, i. e., they were obtained with allowance for the possible process $\pi^- d \to 2n$. If we use for the absorptive part the result of the latest paper (-0.007 + i0.006) F together with our result for the third Moravcsik function, then the total anser is

$$a_{\pi d} = (-0.064 \pm 0.016 + i0.006) \text{ F}. \quad (5)$$

The experimental figure was given above (2). If we invert the problem and use the value (2) together with the result of a theoretical calculation with the third Moravcsik function to obtain the parameter b_0, we get

$$b_0 = -0.026 \pm 0.013 \text{ F}. \quad (6)$$

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