shift of our inelastic curves, we have seen that our calculations agree with the lower inelastic curve for a value of a_0 equal to 1.537×10^{-13} cm calculated from Swiatecki's formula. For the same a_0 the elastic curve agrees tolerably well with the experimental one. For a choice of 2.0×10^{-13} cm for a_0, the θ dependence of our inelastic curve can be matched with that of the upper inelastic curve. For the same a_0 the elastic cross-section curve gives poorer agreement. Finally, since the errors in the experimental curves are not indicated, it seems that we cannot determine a_0 very accurately in the above way.

For C^{12} we have determined $a_0=1.582\times10^{-13}$ cm, which is considerably lower than the value $a_0=1.692\times10^{-13}$ cm obtained from Swiatecki's formula. We observe that this determination of a_0 is not unique in view of the experimental errors. The above choice of a_0 has reproduced the experimentally observed trend of $\mathcal{C}^2$ *vs* K curve below $K=1.2\times10^{13}$ cm^{-1}; above this value the theoretical curve drops while the smooth curve drawn in reference 3 does not show any such trend. We remark that the large errors in the experimental data allow much freedom in altering the experimental curve in this region, and hence no definite conclusions can be made. With the same value of a_0, we have found the trend of our inelastic $(J'\neq J)$ $\sigma(\theta)$ *vs* θ curve to agree fairly well with the observed data within experimental errors.

We emphasize that all our calculations for C^{12} have been directed to testing the qualitative features of the inelastic curves, and the deliberate simplifications we have made in finding the wave functions of Be^9 do not permit us to claim anything quantitatively there also. Further limitations of our method of calculation have been pointed out in the introductory section. The neglect of interaction through the magnetic moment, which will increase the cross section, has also been mentioned in an earlier section.

The calculations reported here have been made principally with a view to testing whether, without going into the detailed procedure of wave-function calculation, we get any evidence from the experimental data contradicting some qualitative feature of our formula. Fortunately we have not obtained any such evidence. To test quantitatively the cross-section formulas, especially those for inelastic scattering, we are at present determining exact wave functions for C^{12} by reproducing the known energy levels after an exact diagonalization of the energy matrices. The nuclear Hamiltonian assumed is in conformity with two-body binding and scattering data. The scattering cross section obtained with such wave functions will be reported elsewhere in due time.

Pending such detailed quantitative testing, we make a passing observation that the inelastic $(J'\neq J)$ $\sigma(\theta)$ *vs* θ curve calculated by our formula allows a more satisfactory determination of a_0 than is obtained by the method of Swiatecki.[17]

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Interference Phenomena of K^+-Meson Scattering by Nuclei*

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An analysis of the elastic scatters of K^+ mesons in emulsion shows that the data favor a repulsive nuclear potential. A description of the analysis of the experimental results is given.

An analysis of the elastic scattering of K^+ mesons in emulsion has been made using the Born approximation. It is found that the data favor a repulsive nuclear potential when compared with the theoretically predicted curves.[1]

The Born approximation gives the differential cross section for K^+ mesons as

$$d\sigma/d\Omega=[Zf_p+(A-Z)f_n\pm Zf_C]^2F^2 \text{ (elastic or coherent)}$$
$$+[Z(f_C\pm f_p)^2+(A-Z)f_n^2][1-F^2] \text{ (inelastic or incoherent),}$$

where f_C, f_p, and f_n are the Coulomb, proton, and neutron scattering amplitudes and F is the nuclear form factor. The plus or minus sign is chosen depending on whether the nuclear and Coulomb forces are of the same or opposite sign, i.e., whether the nuclear potential

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[1] L. S. Osborne, Phys. Rev. 102, 296 (1956).

is repulsive or attractive. The Born approximation is assumed valid because the cross section is found experimentally to be small.[2]

In order to calculate the form factor, a nucleon distribution $\rho(r)$ must be assumed. Charge distributions that give a best fit using the Born approximation for electron scattering experiments[3] are the uniform and Gaussian model for light elements and the exponential model for heavy elements. The resulting form factors are a function of K, where $K=2k\sin(\theta/2)=(2p/\hbar)\times\sin(\theta/2)$ (the "momentum" transfer for scattering of the meson at an angle θ), and of the parameters r_0, which are chosen appropriately for each model and which depend on A. In this analysis, the assumption is made that neutrons are evenly distributed among protons so that the nucleon distribution is given by the charge distribution.

The values of f_p and f_n were determined from the inelastic cross section. For large values of K, the form factor and the Rutherford cross section are negligible and the observed cross section is the inelastic part, which becomes $d\sigma/d\Omega=Zf_p^2+(A-Z)f_n^2$. Because it is experimentally difficult to distinguish an elastic scattering from a scattering resulting in a very small energy loss, a scattering event was classified as inelastic if $K>9\times10^{12}$/cm. This limit is consistent with the fact that, for scattering from a Gaussian or exponential model, the resulting theoretical elastic differential cross section becomes less than the inelastic differential cross section at this value of K.

The inelastic cross section was found to be isotropic with angle and not to vary with energy, in agreement with previous data.[2] Letting $A=2Z$ and averaging over all angles and energies give

$$(f_p^2+f_n^2)=(7.60\pm1.74)\times10^{-28}\ \text{cm}^2/\text{sterad},$$

which agrees very well with the previous data. From this, the values of f_p and f_n are given if the relative contribution of each is determined. This ratio is known from the ratio of charge exchange to noncharge exchange if the reaction takes place in a single isotopic spin state. The data[2] favors the $T=1$ state, which gives $f_p=2f_n$.

With the values of f_p and f_n thus determined, the elastic cross section (which is the observed cross section for small K) is shown as a function of K in Fig. 1 for both an attractive and a repulsive nuclear potential for each distribution. The curves depend strongly on the relative sign of the nuclear and Coulomb forces.

The experimental data was obtained from three

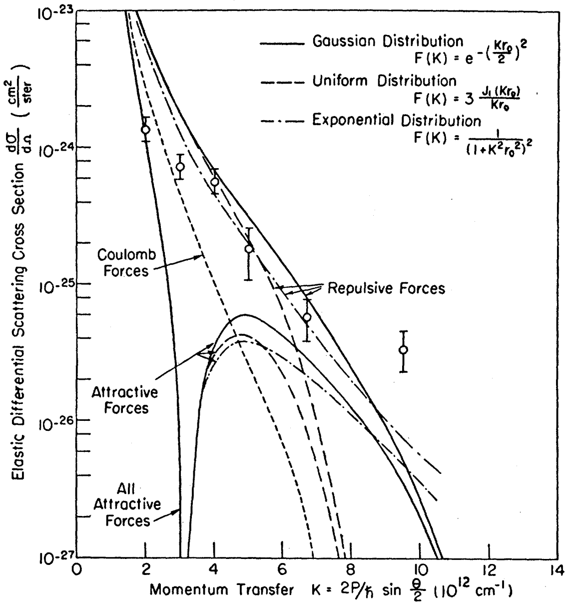

FIG. 1. K^+-meson elastic scattering cross section.

stacks of emulsion exposed to focused and magnetically analyzed K^+-meson beams at the high-energy accelerators, the Berkeley Bevatron and the Brookhaven Cosmotron. "Along the track" scanning resulted in the following of 19 meters of track in the kinetic energy interval 10–150 Mev, and 10 meters of track in the interval 0–70 Mev. For the values of K concerned, the energies and angles are such that multiple scattering could not be mistaken for true events.[4]

The experimental values of the differential elastic cross section are also shown in Fig. 1. The data fall close to the curves predicted for a repulsive nuclear potential. Furthermore, the slope of the experimental cross section is always negative and does not indicate the pronounced dip predicted for an attractive force. Thus the data favor a repulsive nuclear potential. This conclusion is also indicated by the fact that the data lie well above the cross section predicted for a pure Coulomb potential. The low experimental value of the cross section at $K=2\times10^{12}$/cm can be explained by inefficiency for detecting small angles in the scanning. Similarly, previous data analyzed by this method[1,2] may possibly reflect a lack of efficiency when they show a dip in the differential cross section at small angles.

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[2] *Proceedings of Sixth Annual Rochester Conference on High-Energy Physics, 1956* (Interscience Publishers, Inc., New York, 1956), Chap. VI.

[3] Hofstadter, Fechter, and McIntyre, Phys. Rev. **92**, 978 (1953); Hofstadter, Hahn, Knudson, and McIntyre, Phys. Rev. **95**, 512 (1954); J. H. Fregeau and R. Hofstadter, Phys. Rev. **99**, 1503 (1955); L. I. Schiff, Phys. Rev. **92**, 988 (1953).

[4] For low energies, the angles are so large that multiple scattering and true events are easily distinguishable; for high energies, the tracks are relatively straight and multiple scattering cannot be mistaken for even small angles, i.e., $\theta\sim5°$.