an s state predominates in the production at this energy.

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ELASTIC SCATTERING OF K^- MESONS BY NUCLEI

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This note describes a measurement of the small-angle elastic scattering of K^- mesons of energy 144-106 Mev by the nuclei in photographic plates. The experimental reaction cross section and elastic differential cross section have been compared with cross sections obtained by exact numerical solution of the Klein-Gordon equation in which the K^--nucleus optical model potential, $V(r) = (U - iW)f(r)$, is taken to be the fourth component of a relativistic 4-vector. This method of measuring U is more direct and precise than the method based on the energy loss in K^--meson inelastic scattering.[1] We find that the most probable value of U is -30 Mev (i.e., attractive). Using the approximation $V(r) = \rho(r)\langle t\rangle$ (based on the impulse approximation), where $\rho(r)$ is the nuclear density and $\langle t\rangle$ is the K^--nucleon transition matrix for forward scattering, the sign of U depends on the sign of the real part of the K^--proton s-state scattering length,[2] which is of importance in the evaluation of the K-nucleon forward scattering dispersion relations.[3-5]

A stack of 240 pellicles of Ilford $K.5$ nuclear photographic emulsion, each 15×22.5 cm^2 and of 600μ thickness, was exposed to the 435-Mev/c electromagnetically separated K^- beam of the Bevatron at Berkeley. K^--meson tracks were followed for approximately 3.7 cm starting from a plane where the average energy was 144 Mev. For 6.97 meters of track the real angle of scattering was calculated for all elastic scattering events with projected angle $\phi \geq 1.5°$. The same procedure was adopted for a further 12.06 meters of track for elastic scattering events with $\phi \geq 2.0°$. 23.00 meters of track were scanned for decays in flight and all inelastic events. This gave a mean free path in the energy interval 144-106 Mev of $30.7^{+4.0}_{-3.2}$ cm for all inelastic processes. Combination of this result with results for the same energy interval published by other workers[6,7] gives a mean reaction cross section for the nuclei of photographic plates of 710 ± 44 mb.

For each elastic scattering, the momentum transfer was calculated in addition to a correction factor for solid angle and for the finite resolution of the detecting apparatus. The scattering events were divided into intervals of momentum transfer (q) of 20-25, 25-30, 30-40, 40-50, 50-65, and 65-96 Mev/c. For each interval the experimental value of the mean $d\sigma/dq$ (mb per Mev/c) was calculated. Theoretical values of this quantity and of the mean reaction cross section were calculated by exact numerical solution of the Klein-Gordon equation at a K^- energy of 125 Mev, the emulsion nuclei being represented with only a very small error by nuclei of $A = 94$, $Z = 41$, and $A = 14$, $Z = 7$ with weights 0.435 and 0.565. For comparison with the experimental $d\sigma/dq$, the theoretical values were integrated over each of the six intervals of momentum transfer. We assume that $V(r)$ is independent of mass number and choose for $f(r)$ the Saxon-Woods form[8] with $r_0 = 1.07\, A^{1/3}\times10^{-13}$ cm and diffuseness parameter $a = 0.57\times10^{-13}$ cm.

We have obtained eleven sets of the two free parameters U and W ($-60 \leq U \leq 60$ Mev) which

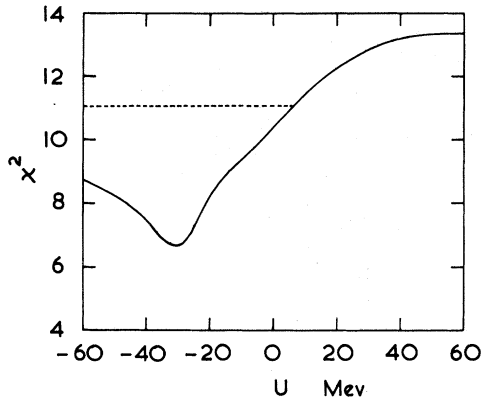

FIG. 1. χ^2 is shown as a function of U. The broken line shows the 5% level of significance.

give a mean reaction cross section of 710 mb. The $d\sigma/dq$ predicted by each set are compared with the experimental values in Fig. 1, which shows the value of the parameter χ^2 as a function of U. The lowest value of χ^2, 6.70 for $U=-30$ Mev, is satisfactory for five degrees of freedom. The 5% level of significance, shown by the horizontal broken line, corresponds to $U=+6$ Mev. In Fig. 2, $Y=(d\sigma/dq)/(d\sigma/dq)_{\text{Rutherford}}$ is shown as a function of q. The experimental points are compared with the values of Y given by the sets (*a*) -30-37*i* Mev, (*b*) +20-52*i* Mev. $d\sigma/dq$ is most

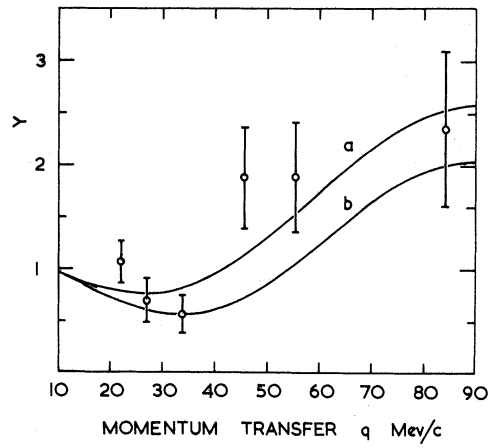

FIG. 2. The experimental values of $(d\sigma/dq)/(d\sigma/dq)_{\text{Rutherford}}$ are compared with those calculated for the potentials (a) -30-37*i* Mev, (b) +20-52*i* Mev.

sensitive to changes in U for $q \simeq 50$ Mev/c. It is important to note that the experimental correction factor is large (>1.4) only for the points at $q=22$ and 27 Mev/c. At $q=50$ Mev/c we may neglect inelastic scattering and Coulomb excitation.

If the reasonable assumption is made that K^--nucleon p-wave contributions to $\langle t \rangle$ are insufficient to change the sign of U, then the result $U=-30$ Mev agrees with the (a+) and (b+) s-state scattering length solutions of Dalitz and Tuan,[2] but is in poor agreement with the (a-) and (b-) solutions. The value of U at lower K^- energies would be useful, but at 70 Mev, owing[9] to the large value of W, the elastic scattering is almost insensitive to U.

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