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p-p PHASE SHIFT SOLUTIONS AND DEPOLARIZATION SCATTERING PARAMETER AT 210 Mev*

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Recently MacGregor and Moravcsik[1] have applied their modified phase shift analysis[2,3] to the Rochester proton-proton scattering data: cross section σ, polarization P, and the triple scattering parameters[4] A and R at 210 Mev.[5] Of their four sets of phase shifts (a through d) with lowest values of χ^2, they have excluded two (a and d) primarily on the ground that neither corresponds to one of the two acceptable phase shift solutions at 310 Mev.[3]

The Rochester nucleon-nucleon scattering program at 210 Mev has been extended to include measurement of the depolarization parameter,[4] $D(\theta)$, in p-p scattering. The preliminary data, which have been obtained thus far at 30° and 60° in the center-of-mass system, are of interest in that they definitely exclude solutions a and d of the MacGregor-Moravcsik analysis, and further indicate some preference for solution b over solution c. In addition, the data indicate an overall energy dependence for $D(\theta)$ consistent with the Harvard measurement at 150 Mev.[6,7]

The 90% polarized proton beam was scattered from a liquid hydrogen second target at an angle θ in the plane of the first polarizing scattering. The polarization perpendicular to the scattering plane for protons which scattered right and left from the second target was measured with the polarimeter[8] which employed a carbon third target and a pair of triple counter telescopes.

The twice scattered beam was defined by the illuminated volume of the hydrogen target and by a slit placed just before the third target. The polarimeter was aligned along an axis defined by two points in space: (1) the geometrical center of the slit, and (2) the center of gravity of the twice scattered beam at a distance of 35 in. beyond the slit. The uncertainty in the alignment was estimated to correspond to ± 0.003 in asymmetry, while the minimum asymmetry observed in the measurement of $D(\theta)$ was 0.110. Additional sources of spurious asymmetry resulted from the nonuniform illumination of the third target and the beam energy variation across it due to the angular dependence of the p-p scattering cross section and the kinematics. To estimate these effects, the polarimeter was calibrated with the degraded beam which passed through a wedge absorber and a collimator before striking the third target. The absorber and the collimator produced the energy and intensity variations that were expected in the hydrogen scattered beam. Each of these two effects gave a spurious asymmetry of 0.005± 0.006.

After making corrections for these asymmet-

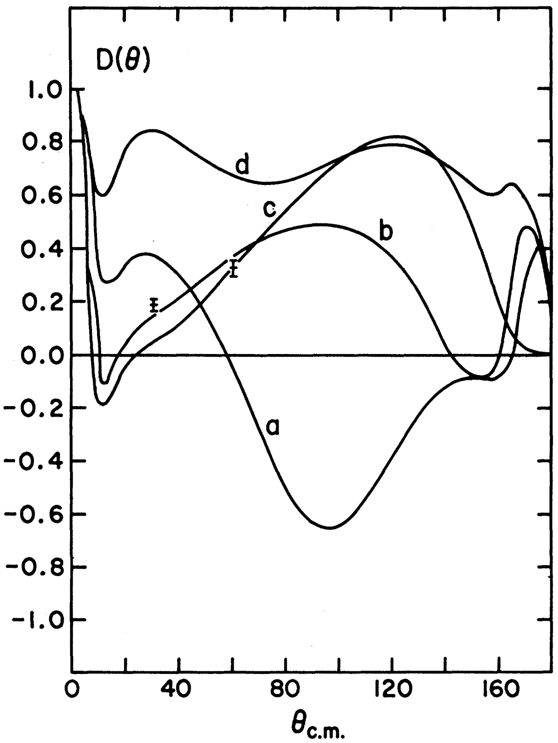

FIG. 1. Depolarization parameter $D(\theta)$ in p-p scattering at 210 Mev, with the predictions of phase shift solutions a through d.

ries, separate values of $D(\theta)$ for right and left scatterings were calculated from the observed asymmetries and the p-p polarization data[5] at this energy. The values of $D(\theta)$ obtained for left and right scatterings were then combined statistically, giving the following result:

$$D(30°) = 0.19 \pm 0.02,$$

$$D(60°) = 0.33 \pm 0.03.$$

The errors include the above-mentioned uncertainty in alignment. Figure 1 shows the experimental points along with the predictions[1] of solutions a through d. Our preliminary values of $D(\theta)$ at 210 Mev strongly substantiate the choice[1] of solution b or c and indicate some preference for b over c. With the $D(\theta)$ values at 310 Mev, the data yield an over-all energy dependence of $D(\theta)$ which favors the $D(\theta)$ measurement at 150 Mev by the Harvard group[6] rather than the Harwell result.[7]

The accuracy of the data is being improved and the work extended to other angles.

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CAPTURE OF K^- MESONS FROM HIGH S ORBITALS IN HELIUM*

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It would be quite interesting to know from which atomic orbital a K^- meson will be captured after stopping in liquid helium. For, if it can be established that, in all likelihood, the capture of the K^- meson occurred from S states, a study of the angular distribution of the mesonic, two-body decay of the hyperfragment ${}_{\Lambda}He^4$ or ${}_{\Lambda}H^4$ can determine the spin of the hyperfragment. If the spin of the ${}_{\Lambda}H^4$ or ${}_{\Lambda}He^4$ turns out to be zero, then the experiment of Block et al.[1] determines that the K^--Λ parity is odd.

The problem for helium is completely different and quite a bit more complicated than that for hydrogen, studied previously.[2,3] As a consequence, the result is not as conclusive as that for hydrogen, although it does indicate that S-state capture will again predominate.

We will outline qualitatively, here, the principal processes which occur after K^- mesons are stopped in a liquid helium bubble chamber.[4] When the K^- meson is first captured by a helium atom (into a state which best overlaps the wave function of the electron it replaces, i.e., with principal quantum number $n \sim 30$), it almost immediately de-excites and kicks out the remaining electron by the usual Auger process. The state to which it must fall about the unshielded alpha particle in order to release the 24.56 ev electron ionization energy has $n \sim 27$, and an average radius of $\sim 0.4 a_{\text{el}}$ (electronic Bohr radius). This is substantially smaller than the electron's average radius in a helium atom, and so, the $(K^-, \alpha)^+$ atom looks roughly like a proton to the surrounding helium atoms. In particular, it is energetically forbidden to pick up another electron.[5,6]

This, then, leads to an examination of the atomic and molecular processes in which a $(K^-, \alpha)^+$ atom can participate.[7] One possibility is that a metastable molecule might be formed with another helium atom. The $(p, \text{He})^+$ molecule is well known,[8,9] although the three-body recombination problem involved in its formation has not been studied extensively in liquids.[10] However, while these recombination times are expected to be very short, it is not essential for our purposes, here, that the molecule actually form. Rather, we make only the simpler assumption that the $(K^-, \alpha)^+$ atom feels the molecular