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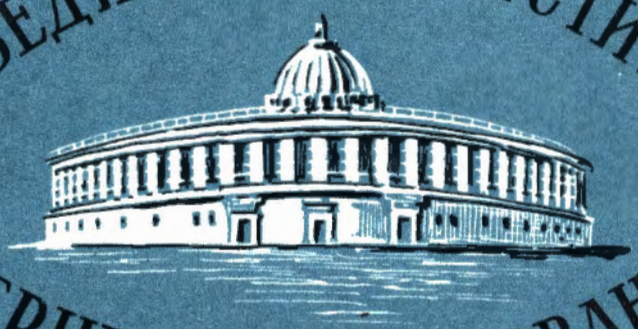

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ON THE SPIN CORRELATION COEFFICIENT C_{nn} FOR 310 MEV pp-SCATTERING AT 90° (c.m.s.)

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A phase shift analysis has been made on the data of the whole set of experiments on elastic proton interaction at 310 MeV performed at Berkeley. The analysis has not included studies on the spin correlation of scattered protons. This analysis[1], as is known, has led to an ambiguous result. From all possible solutions five independent sets of phase shifts satisfactorily describing experimental data have been chosen. The obtained solutions have led to different values of the coefficient $C_{nn}(90^\circ)$ which determines the correlation between spin components normal to the scattering plane. Thus, for those sets of phase shifts which are denoted by numbers 1, 2, 3, 4 and 6 the value $C_{nn}(90^\circ)$ have been found to be 0.158, 0.711, 0.300, 0.490 and 0.425[2], respectively.

In this connection the experimental investigation of the spin correlation of scattered protons at an energy of 310 MeV became of great importance and at a number of laboratories (Berkeley, Liverpool and Dubna) preparations were begun for running a complicated experiment on the determination of $C_{nn}(90^\circ)$.

However, further an essential decrease of ambiguity of the analysis was achieved by developing and improving the phase shift analysis on nucleon-nucleon scattering itself[3,3a]. Originally, the performed analysis included 14 phase shifts from states up to the H-wave inclusive. In[3] the authors have taken into account the contribution from states with greater orbital moments on the basis of one meson approximation developed in[4,5]. This additional contribution is calculated in the first approximation of the perturbation theory and adds to the analysis only one new parameter the pion-nucleon coupling constant g^2. A modified analysis permits one to state that only the first and the second sets of phase shifts satisfactorily describe the experimental data with $g^2 \sim 14$. The value of the coefficient $C_{nn}(90^\circ)$ becomes to be equal to 0.38 for the first set and 0.61 for the second one in connection with the new values of the phase shifts of the chosen sets.

The first experiments on the determination of $C_{nn}(90^\circ)$ carried out in Liverpool at 320 MeV proton energy and at Dubna at 315 MeB witness in favour of the second set of phase shifts, as it has been pointed out at the Kiev Conference on High Energy Physics[6]. Thus, the Liverpool group has found the spin correlation coefficient to be $C_{nn}(90^\circ) \simeq 0.75 \pm 0.11$. Our measurements performed by using preliminary data on the calibration experiment on the determination of the polarization ability of graphite analysers has led to $C_{nn}(90^\circ) \simeq 0.7 \pm 0.3$.

At present we have finished an experiment on the determination of the analysing ability of carbon scatterers. The calibration experiment has been performed with the 160 MeV proton beam, the polarization of which has been found to be 0.667 ± 0.027. The polarization ability of the analysers employed in the measurement of the correlation asymmetry has been obtained to be equal to 0.28 ± 0.02. Taking into account that the value of the coefficient C_{nn} cannot exceed a unit, we have

$$C_{nn}(90^\circ) \simeq 0.84 \begin{matrix} +0.10 \\ -0.22 \end{matrix}$$

Hence, the obtained large experimental value of the coefficient C_{nn} is difficult to put in agreement with the value predicted on the basis of the first set of phase shifts.

The estimates of the contribution of the singlet interaction b^2 and the triplet interaction c^2 (spinorbital) and h^2 (of the tensor type) have been made on the basis of earlier experimental data on elastic pp-scattering at 310 MeV. Thus, Wolfenstein/7/ has found that $15\% < b^2 < 60\%$, $35\% < c^2 < 70\%$ and $2\% < h^2 < 20\%$. The evaluations of Nurushev/8/ are the following: $b^2 \simeq 25\%$, $c^2 \simeq 62\%$ and $h^2 \simeq 13\%$.

From the relations

$$b^2 = \tfrac{1}{2}\,(1 - C_{nn})$$

$$4\,c^2 = (1 + C_{nn} + 2D)$$

$$4\,h^2 = (1 + C_{nn} - 2D)$$

on the basis of the obtained value $C_{nn}(90^\circ)$ and the value $D(90^\circ) = 0.42$ found by the extrapolation of data/2/ the corresponding contributions are obtained to be $b^2 \simeq 8\%$, $C^2 \simeq 67\%$ and $h^2 \simeq 25\%$.

During last time the situation with choosing sets of phase shifts describing elastic pp-scattering at 310 MeV somewhat changed in connection with the modified phase shift analysis of previous experimental data/9/. The modification of the analysis consisted in the reduction of the number of the used phase shifts and in the expansion of one meson approximation to states with relatively less orbital moments. The performed analyses including 5, 7 and 9 phase shifts have shown that if 9 phase shifts instead of the previous 14 ones and the pion-nucleon coupling constant g^2 are taken into account, one obtains quite a satisfactory description of the same experimental data in the case of the second and especially of the first set of phase shifts. Besides the values of the coefficient $C_{nn}(90^\circ)$ calculated from recently found phase shifts have turned out to be 0.41 for the first and the second sets. In connection with this the authors/9/ consider that in order to remove the ambiguity of two sets of phase shifts it is necessary to measure the value C_{kp} at 45°.

However, a new analysis with 9 phase shifts and the constant g^2 has led not only to the disappearence of difference in the coefficient $C_{nn}(90^\circ)$ for the first and the second sets of phase shifts but also to the value of the coefficient which contradicts the available experimental data. From our point of view this discrepancy should be treated as an indication on the insufficiency of 9 phase shifts taken into account in the last analysis. Introducing into the analysis experimental data on determination of the value $C_{nn}(90^\circ)$ in the case with 9 phase shifts would lead, evidently, to an overstatement of the goodnesse-of fit parameter, χ^2, as it occurs in the analysis of experimental data which do not include the values of C_{nn} when only 7 phase shifts are taken into account.

On the basis of the analyses which take into consideration 7 and 9 phase shifts the first set is preferred[9]. But when large data, obtained from the experiment on the determination of $C_{nn}(90^\circ)$, and 14 phase shifts and the constant g^2 are taken into account, as it was stated in[10], both sets give goodness-of-fit parameters just within the range of 50% probability. More accurate measurements of several data used in the analysis will be evidently needed in order to avoid ambiguity in the determination of sets of phase shifts.

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