

EXPERIMENTAL INVESTIGATION OF NUCLEON-NUCLEON INTERACTION AND PHASE ANALYSIS OF NUCLEON-NUCLEON SCATTERING IN THE ENERGY INTERVAL 20–630 MeV

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Current experimental data enable the phase analysis of nucleon-nucleon scattering at energies of 23.1, 40, 52, 66, 95, 126, 147, 210, 310, and 630 MeV.

The scattering amplitude at energies of 147 and 210 MeV was uniquely reestablished. In the remaining cases the situation is less favorable (the number of solutions varies from two to four). However, on the basis of the monotonic character of the energy dependences of the phase shifts it is possible to find the most probable solution for all the above enumerated energies.

The phase analysis was based on the following assumptions:

- 1) nuclear forces are independent of charge;
- 2) the interaction of nucleons in states with large orbital momenta is correctly described by Feynman's one-meson diagram;
- 3) the orbital momenta for which the one-meson approximation becomes applicable, are determined by the fact that in the one-meson approximation the polarization is equal to zero [1];
- 4) the formation of π mesons takes place mainly in accordance with the resonance model from initial states with total isotopic spin $T = 1$.

The latest phase-analysis experiments were carried out in Dubna for energies of 23.1, 52, 66, 126, and 630 MeV. In the energy

interval from 23 to 66 MeV $l_{\max} = 2$ and at 126 MeV $l_{\max} = 3$. The phase analysis for 630 MeV was based on the assumption that the one-meson approximation holds for momenta starting from $l_{\max} = 6$.

The scarcity of experimental data precludes the obtaining of unique solutions in the energy interval from 23.1 to 126 MeV, if only the χ^2 -criterion is used for selecting the solutions. However, the number of solutions can be considerably reduced by assuming a smooth variation of the phase shifts with energy.

The solutions given in Tables 1 and 2* were obtained by such a selection. The experimental values calculated on the basis of the phase shifts thus obtained were confirmed in subsequent experiments. They include the measurement of C_{nn}^{pp} (90°) at an energy of 52 MeV [2], the depolarization in np -scattering at an energy of 22.5 MeV, and the parameter A^{pp} at an energy of 47.5 MeV [3].

At 630 MeV the solutions are strongly dependent on the assumptions regarding the character of the meson-formation processes. Four sets of phase shifts, equally probable with respect to the χ^2 -criterion, were found.

The results can be of significance for the planning of future experiments.

* See paper by Kazarinov (pages 65–68).