Brief Communications

ISOTOPE EFFECT AND PROTON POLARIZATION IN ELASTIC SCATTERING BY NICKEL NUCLEI

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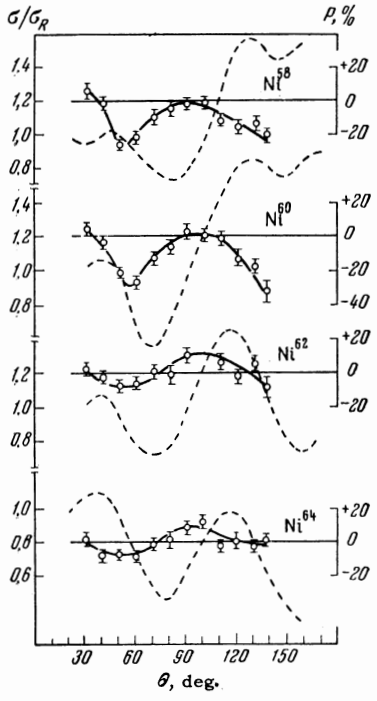
PASECHNIK [1] proposed that the isotope effect observed in studies of the elastic scattering of 5-7 MeV protons by separated isotopes [2-7] is related to the proton polarization. The purpose of the present investigation was to obtain data on the polarization of protons in scattering by the nickel isotopes of mass 58, 60, 62, and 64.

The polarization was measured by the double-scattering method. The first scatterer was a self-supported film 3-4 μ thick with an enrichment of at least 94.5% for Ni^{58}, Ni^{60}, and Ni^{62}; the enrichment for Ni^{64} was 79.8%. The second scatterer was a carbon film. A 6.9-MeV proton beam was obtained from a cyclotron. The protons were detected by a telescope consisting of a scintillation spectrometer and a scintillation counter with a thin crystal. The spectrometer and the thin counter were connected to a coincidence circuit; in some measurements the scintillation counters were replaced by proportional counters.



Angular distributions of elastic scattering and polarization in elastic scattering for 6.9-MeV protons scattered by nickel isotopes: dashed curves – elastic scattering angular distribution; solid curves – analysis of polarization data by the method of least squares; points – experimentally measured polarization.

For observation of the difference in the polarization arising in scattering of protons by different nuclei, it was sufficient to measure the product P_1P_2, where P_1 and P_2 are respectively the desired polarization and the polarization of the analyzer. Using Rosen's data, [8] we evaluated P_2 and computed $P_1(\theta)$.

The results of the polarization measurements are shown in the figure, together with the elastic scattering differential cross sections. [4,5] The polarization of protons elastically scattered by Ni^{58} and Ni^{60} is in good agreement with the polarization of protons of the same energy scattered by nickel of the natural isotopic mixture. [9] For Ni^{62} and Ni^{64} the proton polarization is noticeably different from that for Ni^{58} and Ni^{60}, especially at large angles.

The angular dependences of the polarization correlate well with the differential cross sections. This agrees with the work of Rodberg [10] in which it was shown that the polarization of elastically scattered protons is proportional to the derivative of the differential cross section. This correlation is not as good for Ni^{60} as for the other nuclei.

The interaction of the spin of the incident particle with the spin of the target nucleus cannot be the cause of the difference in polarization in the nickel isotopes, since all these nuclei have an identical ground-state spin of zero. The difference in the symmetry coefficient $(N - Z)/A$, apparently, also cannot lead to differences in the polarization.

The small isotopic impurity of the Ni^{58}, Ni^{60}, and Ni^{62} targets could not affect the results of the polarization measurements. The Ni^{64} target had a noticeable amount of impurity in the form of Ni^{58} and Ni^{60} nuclei. By taking into account the Ni^{58} and Ni^{60} results, it can be shown that these impurities only reduce the polarization differences.

Therefore it is natural to suppose that the cause of the difference in polarization in the nickel isotopes may be the difference in the spin-orbit in-

teractions with different nuclei. Calculations largely confirm this supposition.

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ELASTIC SCATTERING OF 13.6 MeV DEUTERONS BY GOLD AND BISMUTH NUCLEI

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SOKOLOV and Lebkova [1] have studied the possibility of describing the elastic scattering of 13.6-MeV deuterons on various nuclei by the optical model and have shown that scattering by heavy nuclei is explained rather well by this model. However, while the theoretical differential cross sections for elastic scattering show striking oscillations as large as 8% in the region of small scattering angles (15-45°), the experimental cross sections [2,3] do not show regular variations. For medium and large scattering angles the data of Gofman and Nemets on the elastic scattering of 13.6 MeV deuterons by gold [2] differ considerably from the data of Cindro and Wall [3] obtained at a deuteron energy of 13.5 MeV. The present work was undertaken to provide better data on the elastic scattering cross sections for deuterons by gold and bismuth at all angles.

The measurements were carried out at the cyclotron of the Scientific Research Institute of Nuclear Physics, Electronics, and Automation at the Tomsk Polytechnic Institute. The deuteron energy was 13.6 MeV. The external deuteron beam was focused by a pair of quadrupole lenses, deflected 30° by a bending magnet, and after passing through an iron shield in a beam pipe was incident