V^{49}	$7/2^- \to 7/2^-$	$J \to J$ (no)	$\alpha_{VA} = (0.32B^2 - 2.1B)/(1 + 1.42B^2)$
Fe^{55}	$3/2^- \to 5/2^-$	$J \to J+1$ (no)	$\alpha_{VA} = -0.6$
Ge^{71}	$1/2^- \to 3/2^-$	$J \to J+1$ (no)	$\alpha_{VA} = -0.33$
Mo^{93}	$7/2^+ \to 9/2^+$	$J \to J+1$ (no)	$\alpha_{VA} = -0.78$
Cs^{131}	$5/2^+ \to 3/2^+$	$J \to J-1$ (no)	$\alpha_{VA} = +1$

In conclusion we wish to express our gratitude to V. S. Shpinel' who drew our attention to this effect, and to I. S. Shapiro for his valuable advice and leadership.

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ELASTIC SCATTERING OF PROTONS BY CHROMIUM ISOTOPES AT 5.40 Mev

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WE have investigated the angular distribution of protons scattered elastically by the chromium isotopes Cr^{52} and Cr^{53}. Protons accelerated in a linear accelerator were energy-analyzed by a magnetic field giving a deflection of 24° and sent through a collimation system with a diaphragm opening 2.3 mm in diameter onto a target located in the scattering chamber. The target consisted of thin metallic foils 4 μ thick in the case of Cr^{52} and 0.7 μ thick in the case of Cr^{53}. The protons scattered by the target were recorded in photo-emulsion pellicles 100 μ thick at angles of 20 – 160° every 10°. In the angular region 20 – 70° the plates were placed at distances $r = \text{const}/\sin^2(\theta/2)$, which made it possible to protect the emulsion from the intense "illumination" by protons scattered at small angles by the Coulomb field of the nucleus.

Figure 1 shows the energy spectrum of protons scattered by the nuclei under investigation at an angle of 130°. It is readily seen that the inelastic group of protons is easily distinguishable and that the number of elastically-scattered protons can be counted readily at any angle. We note that the inelastically scattered protons corresponding to the 540-kev level of Cr^{53} are relatively few, which is evidence that this level is weakly excited, while the number of protons corresponding to the 970-kev level is considerable.

The angular distribution of the elastically-scattered protons is shown in Fig. 2. The difference in the scattering is seen to be not only quantitative, but also qualitative. The intensity of the protons scattered by Cr^{52} is 2.5 times as large

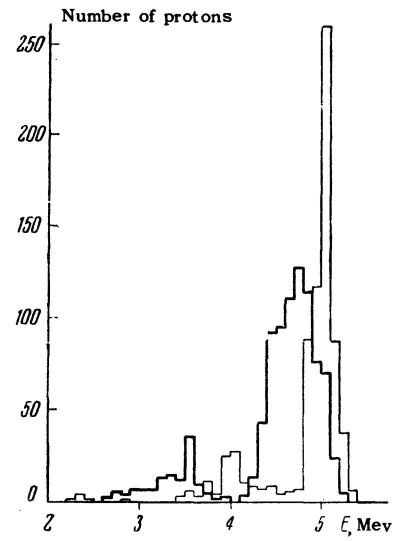

FIG. 1. Proton energy spectrum: heavy line – Cr^{52}, 893 tracks; thin line – Cr^{53}, 729 tracks.

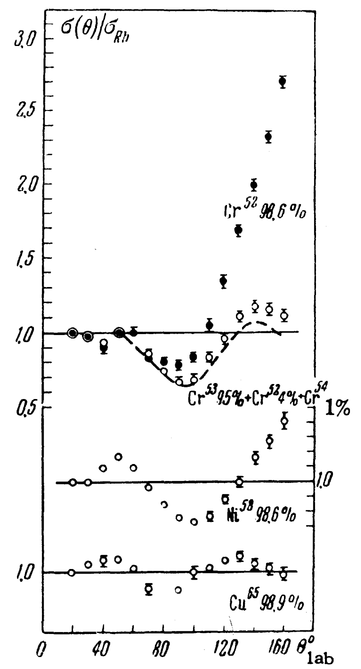

FIG. 2. Ratio of the measured cross section to the Rutherford cross section as a function of the angle of observation in the laboratory system; the dashed curve was obtained from a recalculation of the measured ratio for pure Cr^{53}.

as that for Cr^{53} in the large-angle region, and, moreover, in the case of the former, it increases rapidly and practically linearly with the angle, beginning from the minimum, while for Cr^{53} the curve passes through a maximum in the angular region 140 — 150°. There is also a visible difference in the depth of the minimum of the curves in the region of 90°. The region of small angles has to be investigated more carefully.

Shown for comparison in Fig. 2 are measurements we have made of the angular dependence of 5.45-Mev protons scattered elastically from Cu^{65} and Ni^{58}.[1] From the comparison it follows that the even-even Cr^{52} scatters protons, just like the even-even Ni^{58} and other even-even nuclei [Ni^{60}, Ni^{62} (reference 1), Fe, Ti (reference 2)]. The shape of the angular dependence for even-odd Cr^{53} is similar to the shape for odd-even Cu^{65}.

The results obtained by us are evidence of the fact that a change of one in the number of nucleons in the atomic nucleus, independently of the charge state of the nucleus, essentially changes the interaction between the nucleon and the nucleus. It is possible that the change is the result of a change in the spin of the nucleus in passing from even-even nuclei with spin zero to even-odd or odd-even nuclei with half-integer spin.

In addition, the decrease in the relative cross section for Cr^{53}, in comparison with Cr^{52}, in the large-angle region, apparently can be considered as an increase in the absorption at the boundary of the nucleus, owing to the diffuse surface of the Cr^{53} nucleus due to the addition of an odd neutron.

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ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION $Ca^{40}(d, p)\,Ca^{41}$

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THE theories of stripping reactions[1,2] give a surprisingly good overall agreement with many experiments, in spite of the fact that they do not take into account the Coulomb and nuclear interactions of the deuteron and proton with the nucleus, and compound-nucleus formation. In addition, the calculations have been carried out in the Born approximation, which can hardly be justified at low and medium deuteron energies. In a series of cases, substantial deviations from the predictions of the simple stripping theory have been observed. In some of these cases, these deviations are connected with effects of the Coulomb and nuclear interactions,[3] and in others, with the difference of reaction mechanism from that of pure stripping.[4,5] Therefore, it is of interest to obtain data making it possible to see the effects of the factors mentioned on the angular distributions.

We studied the angular distribution of protons from the reaction $Ca^{40}(d, p)\,Ca^{41}$ leading to the ground, first, and third excited states, for a deuteron energy of 13.6 Mev. The nucleus Ca^{40} was chosen for the measurements, since one might expect a small probability of compound-nucleus formation owing to the closed neutron and proton shells. In addition, at small deuteron energies, strong nuclear interaction is observed,[6,7] and it is of interest to carry out the measurements at higher energies.

The measurements were carried out with the external beam of the cyclotron of the Institute of Physics of the Academy of Sciences, Ukrainian S.S.R. The geometry of the experiment was the same as in previous work.[8] The only difference in the method was that a polystyrene absorber was placed before the entrance to the ionization chamber. It completely stopped deuterons, substantially relieving the amplifier of the chamber, and making it possible to increase the beam on the target. This also led to a complete elimination of background in d-p reactions from deuterons undergoing elastic scattering in the target for values $Q > 2.7$ Mev. The energy resolution was not significantly decreased by this. The target was prepared by vacuum coating and had a thickness of 3 mg/cm^2.

In Figs. 1, 2, and 3 we give the experimental and theoretical (solid lines) angular distributions of protons corresponding to the ground and excited states at 1.95 and 2.42 Mev. The total cross sections for these were in the ratios 1 : 7.5 : 2.5. In