at all temperatures show a minimum in the diffusion coefficient at the ideal composition and a definite increase on the aluminum-rich side. Figure 1 shows this for diffusion at 1250°C, with the data spread indicated. The diffusion of cobalt in samples of the same composition at different temperatures follow the usual law

$$D=Ae^{-Q/RT},$$

thus allowing us to calculate the activation energies for the process at the various compositions of the alloy. The activation energy, as expected, drops off sharply on the vacancy-rich side of CoAl.

These preliminary results have large possible errors and do not determine the exact form of the curve of D as a function of composition. Consequently, the experiment is being continued using a greater number of compositions of the alloy and with emphasis on reducing the many possible errors involved.

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Elastic Proton-Deuteron Scattering at 240 Mev*

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THE elastic proton-deuteron differential scattering cross section at 240 Mev has been measured for proton-scattering angles from 20.5° to 100° in the center-of-mass system. The internal proton beam of the Rochester synchrocyclotron strikes a thin target of heavy paraffin and coincidences between the scattered proton and recoil deuteron are observed using scintillation counters and conventional electronics. The incident beam is determined from the C^{11} beta-activity of the target produced by the reaction $C^{12}(p, pn)C^{11}$. The scattering apparatus, electronics, and beta-counting techniques will be described in detail in a paper to be published on proton-proton scattering performed with the same equipment.[1]

Several types of background coincidences are present. The chance coincidence background is measured by moving the target away from the position at which proton-deuteron coincidences are observed and measuring the coincidences at different beam intensities. The part which varies quadratically with the beam intensity, as monitored by the singles counts in either counter, is ascribed to chance. The linear term is due to events in the carbon in which two charged particles are emitted and reach the counters. For all of the measurements except that at 100° there was a background from inelastic proton-deuteron scattering. Only that portion of the inelastic process which results in a low energy neutron and two protons with approximately the same energy and angular relationship as in proton-proton scattering is observed. For small scattering angles proton-proton scattering from the hydrogen impurity in the target was an additional background. Scattering at 75° and 79° was observed at the same target position. It was not possible to completely separate the two effects. The cross sections at these two angles were obtained by splitting the total number of coincidences in such a way that the center-of-mass cross sections do not differ greatly.

The experimental values of the cross section are given in Fig. 1. The errors indicated at 20.5°, 31°, 42°, 54°, and 100° are the standard deviation in the coincidences. The error on the other points has been increased because of uncertainties in the background. The error in the calibration of the beta-counter is 5 percent. A value of 49 millibarns has been used for the $C^{12}(p, pn)C^{11}$ cross section.[2] The proton-proton scattering cross section at 90° in the center-of-mass system measured with the same apparatus is 4.9 millibarns.

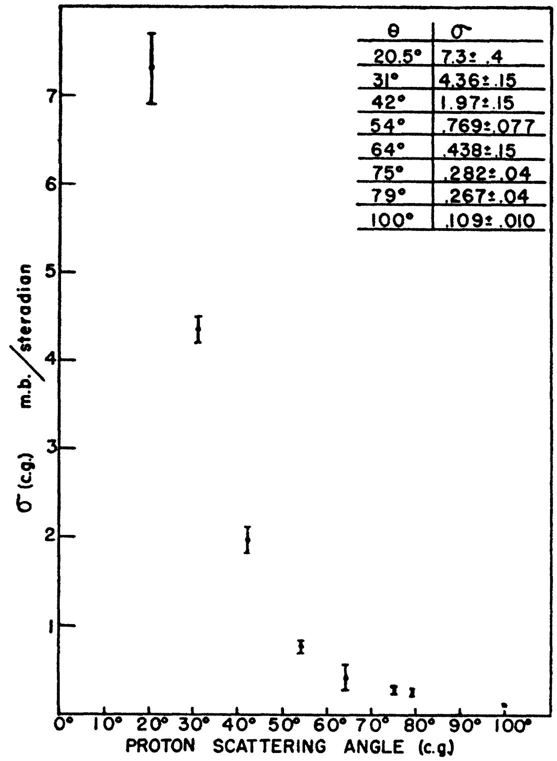

FIG. 1. Elastic proton-deuteron scattering cross section at 240 Mev.

Mr. T. Auerbach, of this laboratory, has calculated the cross section in the Born approximation[3] with the Serber mixture for the neutron-proton interaction and the three proton-proton interactions used by Gluckstern and Bethe.[4] The results of Auerbach's calculation and the experimentally determined cross sections are summarized in Table I. The experimental cross sections do not agree with any of these calculations, which is not surprising since the assumed forces do not explain the observed proton-proton scattering. Further theoretical calculations are clearly necessary.

TABLE I. Theoretical and experimental differential scattering cross sections.

Proton scatt. angle in c.m. system	Theoretical cross section, cm^2/sterad Direct	Pure exchange	Serber	Experimental cross section cm^2/sterad
20.5°	21×10^{-27}	6.0×10^{-27}	13×10^{-27}	$7.3\pm0.4\times10^{-27}$
31°	6.8	1.82	3.9	4.36±0.15
42°	1.95	0.55	1.06	1.97±0.15
54°	0.55	0.145	0.30	0.769±0.77
64°	0.24	0.052	0.112	0.44±0.15
75°	0.104	0.016	0.026	0.28±0.04
79°	0.083	0.010	0.017	0.27±0.04
100°	0.040	0.001	0.014	0.109±0.010

Some data have been obtained on the inelastic scattering mentioned above. These data will be published later with a more detailed discussion of the elastic scattering.

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