the desired interaction are of the form $V(\mathbf{r})\{1(\vec{\sigma}_i+\vec{\sigma}_j)\}$[5]. The existence of a strong spin-orbit interaction is an indication of the presence of such forces, and the interaction constant expresses their magnitude in relation to central forces in the nucleon-nucleon interaction.

I wish to express my thanks to L. D. Landau and A. S. Kompaneits for discussion and advice.

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[*] R_0 and δ are chosen according to the potential of Woods and Saxon[6] $V(r)=V_0(1+i\xi)\{1+\exp\times[(r-r_0)/a]\}^{-1}$, $r_0=1.33\ A^{1/3}\times 10^{-13}$ cm, $a=0.49\times 10^{-13}$ cm. In our case this potential can be approximated by a trapezium-shaped well with $R_0=(1.33\,A^{1/3}+1.3)\times 10^{-13}$ cm, $\delta=4.3\ a/R_0$, $V_0=50$ mev, $\xi=0$.

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Modification of Double Proton Scattering Experiments

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SCATTERING of nonrelativistic protons by nuclei of zero spin is described by a two-row scattering matrix.

$$f(\theta,\ \varphi)=A(\theta)+B(\theta)(\mathbf{n}\vec{\sigma}), \qquad (1)$$

where **n** denotes the normal to the plane of scattering, and functions A and B are expressed by phases according to known formulas. The function

$$P(\theta)=(AB^*+A^*B)/(|A|^2+|B|^2) \qquad (2)$$

determines the polarization as a result of scattering of the originally nonpolarized beam as well as the azimuthal asymmetry observed when polarized protons are scattered.

For the experimental determination of P it is necessary to subject the protons to double scattering. By measuring the ratio of intensities for $\mathbf{n}_1=\mathbf{n}_2$ and $\mathbf{n}_1=-\mathbf{n}_2$ equal to

$$R=(1+P_1P_2)/(1-P_1P_2), \qquad (3)$$

we find the product P_1P_2, and if the factor P_1 is known we obtain P_2 (or vice versa). The success of measurement of this kind therefore depends on the existence of a "standard" scattering process for which the dependence of P on the angle of scattering and energy E is previously known. Note that even if both scatterings are by the same kind of nuclei and $\theta_1=\theta_2$, $P_1\neq P_2$ since the energy E_2 before the second scattering is smaller than the initial energy E_1 by the amount of energy imparted to the nucleus, which is considerable in the case of scattering by light nuclei.

The purpose of this note is to describe an experiment which in principle permits the direct determination of P_2. Let the beam of hydrogen molecular ions H_2^+ incident on the scattering target be such that its ratio q of the number of parahydrogen ions to the number of orthohydrogen ions is considerably different from the equilibrium value $q_0=1/3$. Upon entering the target the molecular ions "break up" and the two protons are scattered independently of each other. If two counters register coincidences due to protons from the same molecular ion scattered in directions θ, φ_1 and θ, φ_2, the number of coincidences D is proportional as follows:

$$D\sim\frac{q}{1+q}(F\chi_0,\ F\chi_0)+\frac{1}{3(1+q)}\sum_{m=-1}^{1}(F\chi_1^m,\ F\chi_1^m), \qquad (4)$$

where χ_0 and χ^m are wave functions of the proton spins for the para- and orthomolecules and F is the "direct product" of matrices f_1 and f_2

$$F=f_1(\theta,\ \varphi_1)\times f_2(\theta,\ \varphi_2); \qquad (5)$$

f_1 and f_2 act upon the spin variables of the first and second proton, respectively.

Indicating

$$\chi_{1x} = -2^{-1/2}(\chi_1^1 - \chi_1^{-1}); \qquad (6)$$

$$\chi_{1y} = i2^{-1/2}(\chi_1^1 + \chi_1^{-1}); \quad \chi_{1z} = \chi_1^0$$

and making use of (1) we can write $F\chi_0$ in the form

$$F\chi_0 = A^2\chi_0 - B^2(\mathbf{n}_1\mathbf{n}_2)\chi_0 \qquad (7)$$

$$+AB(\mathbf{n}_1 - \mathbf{n}_2, \vec{\chi}_1) - iB^2([\mathbf{n}_1\mathbf{n}_2], \vec{\chi}_1),$$

from which

$$(F\chi_0, F\chi_0) = \sigma_0^2(\theta)[1 - P^2(\theta)(\mathbf{n}_1\mathbf{n}_2)], \qquad (8)$$

where $\sigma_0(\theta) = |A|^2 + |B|^2$ is the scattering cross section for the nonpolarized beam. The m summation in the right side of (4) is obtained from the condition that when $q = q_0$, $D \sim \sigma_0^2(\theta)$

$$\sum_m (F\chi_1^m, F\chi_1^m) = 4\sigma_0^2(\theta) - (F\chi_0, F\chi_0). \qquad (9)$$

Accordingly, Eq. (4) takes the form:

$$D \sim \sigma_0^2(\theta)\left[1 - \frac{3q-1}{3(q+1)}P^2(\theta)(\mathbf{n}_1\mathbf{n}_2)\right], \qquad (10)$$

and for the determination of P^2 it is sufficient to measure D for $(\mathbf{n}_1, \mathbf{n}_2) \sim 1$ and for $(\mathbf{n}_1\mathbf{n}_2) = -1$.

Unfortunately, the experiment under discussion will require considerably longer exposures than for usual double scattering. Indeed, the maximum permissible current in the incident beam is determined by the ratio of the effect under investigation to the background of chance coincidences. Let ν denote the number of scattered protons entering each of the counters, n the number of H_2^+ ions incident on the target, τ the resolving time of the coincidence circuit. The numbers of true and accidental coincidences are $\nu^2/2n$ and $2\tau\nu^2$, respectively, i.e., the condition $n \ll 1/4\tau$ must be fulfilled. Therefore, even when $\tau \sim 10^{-10}$ sec, the instantaneous value of the current into the target must not exceed 10^8 to 10^9 ion/sec, which is considerably less than current generally used in double scattering experiments. It should be noted that the formation of a molecular ion source of H_2^+ c $q \gg 1$ producing a current of the order of 10^9 ion/sec is apparently quite feasible.

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Isomeric Transition of the Sn^{117*} Nucleus

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A RADIOACTIVE source containing the tin isotope Sn^{117*} was obtained by bombarding chemically pure cadmium with α-particles in the cyclotron. Radioactive tin was obtained by the reactions $Cd^{110}(\alpha, n)Sn^{113}$; $Cd^{114}(\alpha, n)Sn^{117*}$ [1,2]. In addition, reactions with the formation of radioactive indium isotopes took place. The separation of the radioactive tin into pure form was carried out chemically. The irradiated cadmium was first kept for five days. In this time all short lived radioactive isotopes decayed. The central feature of the chemical separation of radioactive tin into pure form was its distillation in the form of bromide, $SnBr_4$, into a collector filled with concentrated hydrochloric acid[3-7]. This sufficed to separate tin and indium. The distillation mentioned above was carried out twice; the first product was radioactive, the second, not. The contents of the distillation apparatus in both the first and second case were radioactive. The experiments carried out gave reason to believe that the source obtained in this way contained radioactive tin. Later on, the γ-spectrum, electron absorption curve, decay curve and electron spectrum of this source were obtained. The results of these experiments agree well with the data in the literature if we consider that Sn^{117*} and Sn^{113} are in the source obtained. The radioactive transformations of these isotopes, in agreement with the published data of Ref. 8, follow the scheme shown on Fig. 1.

Starting from this decay scheme, identification of the peaks of the γ-spectrum from this source was carried out. This spectrum is shown in Fig. 2. It was obtained on a 20-channel luminescence spectrometer developed by G. R. Kartashev. A crystal of NaI was used. Four peaks are indicated on the spectrum. The peak at 154 kev relates to the cascade γ-transition of Sn^{117*}; the peaks at 260 and 398 kev, to the cascade γ-transition of In^{113}. A peak at an energy of 325 kev is also present in the γ-spectrum. Of all possible combinations of