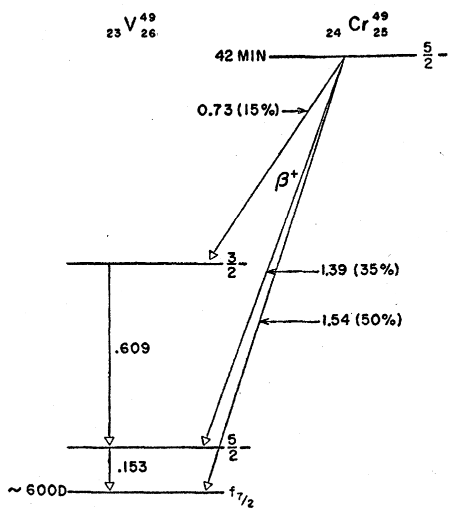

FIG. 1. Decay scheme for Cr^{49} (energies in Mev).

netic dipole gamma-rays. The lack of an observable crossover transition to the ground state agrees with this scheme. This assignment of spins and parities may well result from different coupling of the $(f_{7/2})^3$ proton configuration.

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The Scattering of Slow Neutrons by *Ortho*- and *Para*-Hydrogen

A. T. STEWART* AND G. L. SQUIRES†
Cavendish Laboratory, Cambridge, England
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THE triplet and singlet scattering amplitudes of the neutron-proton interaction may be determined by measurement of the slow neutron cross sections of *ortho*- and *para*-hydrogen.[1] These cross sections, previously measured by Sutton *et al.*[2] and others,[3,4] have been remeasured at the Cavendish Laboratory.

The attenuation of a beam of slow neutrons passing through a specimen of hydrogen gas was measured by moving the specimen in and out of the beam. The specimen, 80 cm long was maintained at a temperature of 20.4°K. Neutrons with various energies between 0.002 and 0.014 ev were selected with the slow neutron velocity selector.

Measurements were made first with specimens of normal hydrogen, 75 percent *ortho* and 25 percent *para*, and secondly with specimens of 99.8 percent *para*-hydrogen, the equilibrium mixture at 20.4°K. Considerable attention was paid to the determination, via thermal conductivity analysis, of the *ortho-para* composition of the specimens.

Absorption and *para*-hydrogen scattering contribute about 3 percent to the normal hydrogen cross section; hence relatively approximate values of these cross sections are sufficient to determine the *ortho*-hydrogen cross section. In the almost pure *para*-hydrogen, however, absorption accounts for about 30 percent of the total so that the value chosen for the absorption cross section affects considerably the value obtained for the *para* cross section.

The elastic scattering cross section of *para*-hydrogen is proportional to f^2 where f, the coherent scattering amplitude, is given by

$$f=2(\tfrac{3}{4}a_t+\tfrac{1}{4}a_s).$$

a_t and a_s are the triplet and singlet scattering amplitudes respectively.

If the absorption cross section σ_{abs}, at 2200 m/sec, is taken[5] to be $\sigma_{abs}=(0.330\pm0.007)\times10^{-24}$ cm², our results give a value of the coherent scattering amplitude:

$$f=-(3.80\pm0.05)\times10^{-13}\text{ cm}.$$

The quoted error of 1.2 percent is the combination of 0.5 percent from the uncertainty in σ_{abs} and 1.1 percent from our experimental measurements. Our value of f may be compared with $f=-(3.90\pm0.12)\times10^{-13}$ cm obtained by Sutton *et al.* in a *para*-hydrogen experiment, and with the value $f=-(3.78\pm0.02)\times10^{-13}$ cm given by Burgy, Ringo, and Hughes[6] from liquid mirror experiments.

The free proton cross section,

$$\sigma_f=4\pi(\tfrac{3}{4}a_t^2+\tfrac{1}{4}a_s^2),$$

calculated from our results for the *ortho*-hydrogen cross section, is

$$\sigma_f=(20.41\pm0.14)\times10^{-24}\text{ cm}^2,$$

which may be compared with the value $\sigma_f=(20.36\pm0.10)\times10^{-24}$ cm² obtained by Melkonian.[7]

A more detailed account of the experiment will be published elsewhere.

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* Now at Atomic Energy of Canada, Ltd., Chalk River, Ontario, Canada.
† Now at Atomic Energy Research Establishment, Harwell, England.
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Noncentral Force Matrix Elements for the Nuclear d^2 Configuration

L. W. LONGDON*
Department of Mathematics, The University, Southampton, England
(Received April 22, 1953)

A STUDY by the writer of the tensor operator algebra of Racah[1] has led to the derivation of expressions for the matrix elements, between two-nucleon states, of the purely orbital operators of the two-body tensor and spin orbit interaction operators:

$$\text{Tensor:}\quad J_t(r)T_{12}\{(\boldsymbol{\sigma}_1\cdot\mathbf{r})(\boldsymbol{\sigma}_2\cdot\mathbf{r})/r^2-\tfrac{1}{3}(\boldsymbol{\sigma}_1\cdot\boldsymbol{\sigma}_2)\}.$$
$$\text{Spin-orbit:}\quad J_s(r)T_{12}\{(\boldsymbol{\sigma}_1+\boldsymbol{\sigma}_2)\cdot(\mathbf{r}\times\mathbf{p})\}.$$

The Slater method of expanding the distance dependence has been used, and the results obtained involve linear combinations of radial integrals in which no particular wave functions or interactions are specified.

In their most general form these results are cumbersome because the coefficients of the radial integrals are Wigner coefficients and the W functions of Racah. Considerable reduction, however, is possible under a restriction to equivalent nucleons or direct and exchange matrix elements. It is hoped that a more detailed report on these formulas will appear elsewhere.

The noncentral force matrix elements for the $(3d)^2$ configuration[2]