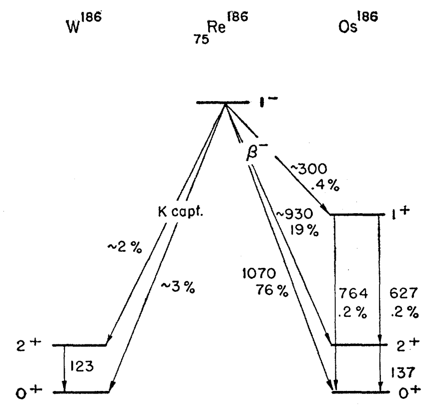

FIG. 1. Decay scheme of Re^{186}.

Sources of 3 mm diameter consisting of the active material in perrhenate form were used. The 926-kev group was measured in coincidence with the 137-kev gamma during four runs on two evaporated sources and was of allowed shape in all cases [Fig. 2(a)]. The total spectrum was followed for four half lives, while the low-situated conversion lines showed a 2 percent resolution and no indication of deformation of the spectrum. A subtraction was made, giving both the 1063- and 926-kev groups allowed shapes consistent with the coincidence runs [Fig. 2(b)]. An experiment was also made to establish the 0.3-Mev group more directly by partially discriminating against the 137-kev gamma ray, thus making the 0.3-Mev group relatively more pronounced [Fig. 2(c)]. The gamma-ray spectrum was checked in the crystal spectrometer.

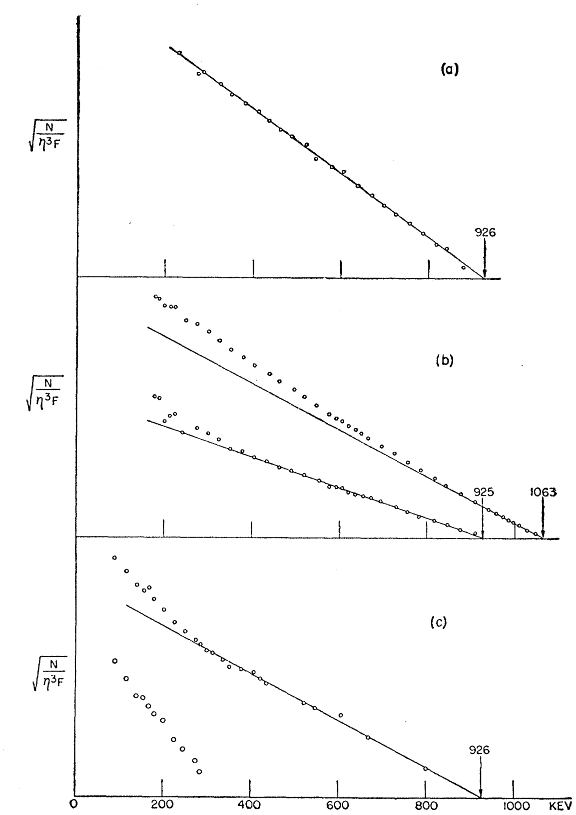

FIG. 2. (a) Kurie plot of the 926-kev spectrum taken in coincidence with the 137-kev gamma. (b) Kurie plots of total spectrum and two groups by subtraction. (c) Kurie plot of coincidence spectra; 0.3-Mev group more pronounced by stronger discrimination.

One concludes from the Kurie plots shown in Fig. 2 that no evidence has been found for a forbidden shape in any of the negatron branches and that consequently the unit spin and odd parity assignment for the Re^{186} ground state should be retained.

The author wishes to thank Professor Chien-Shiung Wu for her continued advice and stimulating interest in the problem, and Miss Noemie Benczer and R. Gold for their help in obtaining the data.

† This work was partially supported by the U. S. Atomic Energy Commission.

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Polarization of Fast Neutrons from Nuclear Reactions

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BLIN-STOYLE[1] and Simon and Welton[2] have pointed out the general theorem that polarized particles may be produced in nuclear reactions by the interference of nuclear states involving spin-orbit coupling. In particular, polarized neutrons may be produced by (p,n) reactions and analyzed by elastic scattering.[3] If the neutrons are emitted at angle θ_1 with respect to the proton beam, and elastically scattered through $+\theta_2$ and $-\theta_2$ in the plane of the reaction, the resultant asymmetry is

$$r_{\pm}=\frac{1-P_1(\theta_1)P_2(\theta_2)}{1+P_1(\theta_1)P_2(\theta_2)},$$

where $P_1(\theta_1)$ is the polarization of the first reaction, and $P_2(\theta_2)$ is the polarization of the second reaction.

The $Li^7(p,n)Be^7$ reaction[4] has a resonance at a proton energy of 2.22 Mev (all angles and energies stated are in the laboratory system) which could produce polarized neutrons by interference with either the known level below 1.88 Mev, or the very broad level at 4.89 kev. Neutrons elastically scattered by O^{16} have a $P_{\frac{3}{2}}$[5,6] resonance at 435 kev which interferes with the $S_{\frac{1}{2}}$ potential scattering. These reactions were used to investigate the degree of polarization obtainable.

Figure 1 shows the geometry of the experiments. A 12-kev thick rotating lithium target was bombarded by protons from the 5.5-Mev Van de Graaff and the resultant neutrons emitted at 42° were elastically scattered through +90° and −90° by a 5-mil wall nickel cylinder, 1 in. in diameter and 4 in. long, containing H_2O and located 8 in. from the target. The scattered neutrons were detected by a hydrogen recoil counter (1 atmos of propane gas) whose sensitive volume was 1 in. in diameter and 4 in. long. This counter was placed a mean distance of 4 in. from the center of the scattering sample and shielded by paraffin wedges from the neutrons coming directly from the target. A bias was chosen so as to discriminate against neutrons multiply scattered by the H^1, but a small correction[7] was necessary for the multiple scattering in the O^{16}. As a check on this correction, an H_2O sample $\frac{1}{2}$ in. in diameter and 2 in. long was used to measure the asymmetry at its maximum value. Backgrounds, ranging from 40 to 70 percent, were measured by removing the H_2O from the cylinder.

The total cross section of O^{16} was calculated by use of the observed[5,6] values of the level parameters and is shown in the lower part of Fig. 2. Its maximum value

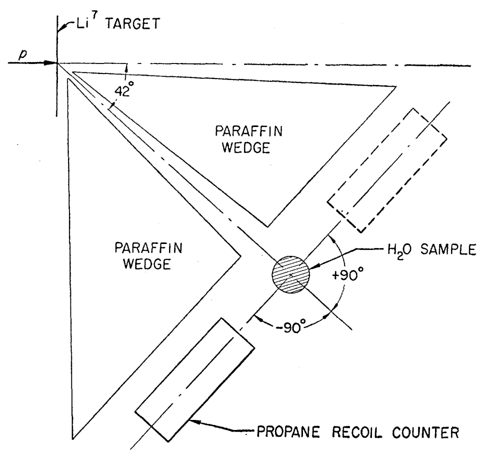

FIG. 1. The geometry for measuring the polarization asymmetry.

is somewhat higher than the measured value, but consistent with the resolution employed (20 kev). The value of $P_2(90°)$ was then computed and is the solid curve in the upper part of Fig. 2 using the left ordinate. The measured values of $P_1(42°)P_2(90°)$ are also plotted in the upper part of Fig. 2 using the right ordinate.

The results are consistent with the known level parameters of the level in O^{17}, and a nearly constant value of $P_1(42°)=0.50\pm0.04$ for the $Li^7(p,n)Be^7$ reaction in this region. This value decreases slowly below 300 kev and above 550 kev. Preliminary measurements[8] which show that this reaction is polarized at 400 kev have been reported, but no value for the polarization is given.

$T(p,n)He^3$ neutrons emitted at $\theta_1=50°$ were also scattered from O^{16}, and the observed value of $P_1(50°)P_2(90°)$ was 0.01 ± 0.04 at 400 kev.

In order to eliminate systematic errors in these measurements, elastic scattering from C^{12}, which has

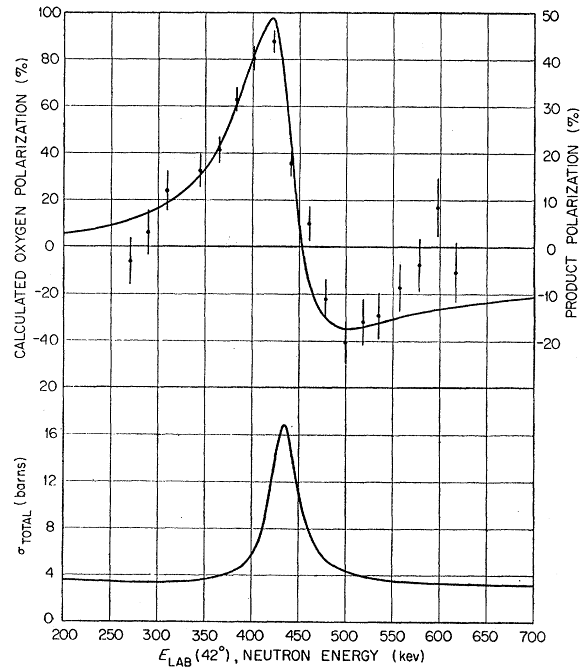

FIG. 2. The lower curve shows the total cross section of O^{16}. The upper curve, using the left ordinate, shows the theoretical polarization for neutrons scattered through 90° by O^{16}. The measured values of the product polarization $P_1(42°)P_2(90°)$ for $Li^7(p,n)Be^7$ neutrons scattered by O^{16} are plotted using the right ordinate.

only s-wave interaction in this region, was used as an analyzer and showed no observable asymmetry (4 percent probable error).

The authors are deeply indebted to Dr. Albert Simon of this laboratory for many stimulating discussions on the subject of polarization.

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Radiative Decay of the θ^0 Particle*

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THE production of soft photons in charged particle transformations has been extensively studied in connection with β decay, K capture, charged meson production, and π- and μ-meson decay.[1] The photon emission in such transformations corresponds to the classical radiation which accompanies the sudden acceleration of a charged particle. Indeed, in the limit