became necessary to repeat the whole variational process with the electronic computer. The final energy value which could be obtained from our 24-parameter function is only about 0.2 cm^{-1} behind that of Kinoshita. Apart from He and H^- the error in the energy value introduced by the incorrect matrix element is less than 1 cm^{-1}. For H^- it is a little over 1.5 cm^{-1}.

However, the contribution from the logarithmic term to the energy value for both large and small nuclear charge Z was still practically the same as before the correction.

This fairly appreciable contribution is larger than would be expected on the basis of the Hart-Herzberg results. Obviously their terms t^2u^2, t^2u^4, s^2t^2 and st^2u, which are not present in our wave function, are better suited to compensate for the logarithmic term than some of the terms used by us.

The old incorrect values together with the corrected ones, all of which have been separately calculated, are given in Table I, $E_2(Z)$ being defined by the formula

$$E=-2Z^2+(5/4)Z+E_2(Z).$$

A detailed account of the calculations will be published in the near future.

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Lifetime of a 1^- Level in Sm^{152}†

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A 961-kev level fed by K capture[1] from Eu^{152m} has been identified[2] as 1^- by internal conversion measurements of the 961- and 837-kev gamma transitions to the 0^+ ground state and 2^+ first excited state of Sm^{152}; the pertinent parts of the decay scheme[1,2] of Eu^{152m} are shown in Fig. 1. The spin of the 961-kev level has been confirmed[3] by an angular correlation measurement of the 1—2—0 gamma-ray cascade. The ratio of the reduced transition probabilities of the 961- and 837-kev transitions is 0.5±0.05, suggesting strongly that the 961-kev level is a member of the $K=0$ rotational band. The log*ft* values of the transitions, shown in Fig. 1, to the ground state levels of Sm^{152} and Gd^{152} and especially the allowed log*ft* value of the transition to the 961-kev level strongly favor odd parity for the 9-hour isomeric state of Eu^{152}. For first forbidden transitions such small *ft* values occur only near double magic nuclei.[4] (The spin-zero assignment to Eu^{152m} seems most reasonable since a search for an isomeric transition >25 kev carried out with a permanent magnetic spectrograph of 0.1% resolution places its mean life as greater than 5000 hours, which is more than 10^{11} times slower than a single-proton $\Delta J=2$ transition.) The total K-capture energy is 890±50 kev, as deduced from the positron spectrum to the ground state of Sm^{152}, measured with a three-crystal pair spectrometer.[1]

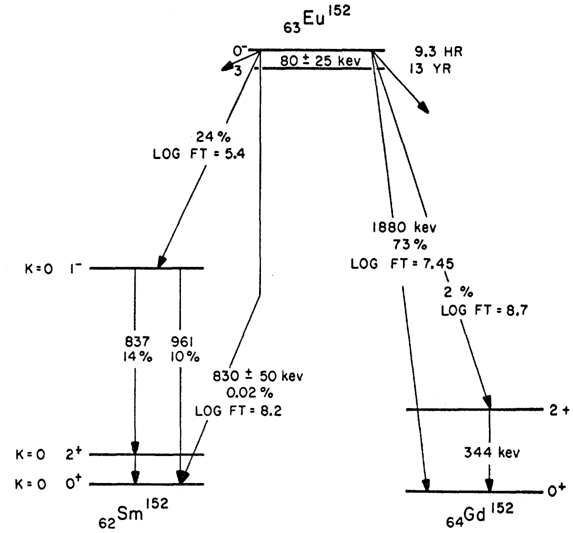

FIG. 1. Partial decay scheme of Eu^{152m}. The spin of the ground state has been measured as 3. {Abraham, Kedzie, and Jeffries, Phys. Rev. **108**, 58 (1957); Manenkov, Prokhorov, Trukhlayev, and Yakovlev, Doklady Akad. Nauk S.S.S.R. **112**, 623 (1957) [translation: Soviet Phys. Doklady **2**, 64 (1957)]; Nuclear Data Card 57-10-21 (National Research Council, Washington, D. C., 1957).}

As is well known,[5] resonance scattering of nuclear gamma rays is normally impossible unless the energy lost in emission and absorption, $\Delta E=E_\gamma^2/Mc^2$, is supplied to the emitted gamma ray. (For a 961-kev transition in Sm^{152}, $\Delta E=6.5$ ev.) However, for electric dipole transitions the ratio of the natural width Γ to ΔE may be large enough so that the wings of the emission and absorption lines can be used to excite the level. [$\Gamma_{961\,\mathrm{kev}}$ (single proton)$\simeq$3 ev.] Also, the mean life of such an electric dipole transition would be short enough ($\tau_{\mathrm{s.p.}}\simeq 2\times10^{-16}$ sec) so that even in a solid source the gamma ray would be emitted before the recoiling nucleus slows down and would therefore be subject to a Doppler shift due to the recoiling nucleus.

The resonant scattering cross section was determined in the standard geometry shown in Fig. 1 of the following paper,[6] but without the magnet. Solid Eu_2O_3 sources and Eu_2O_3 dissolved in HCl were used. In the initial runs,[3] thin ring scatterers of 50 grams each of Sm_2O_3 and Nd_2O_3 were alternated. Since no resonance scattering of any kind was observed with Nd_2O_3, the subsequent runs using 1850 g of Sm_2O_3 were compared with a lead scatterer having a comparable number of electrons. The source strength was determined several days after a run by placing the source in a position corresponding to the mean distance of the scatterer, so that the efficiency of the detector was eliminated to a

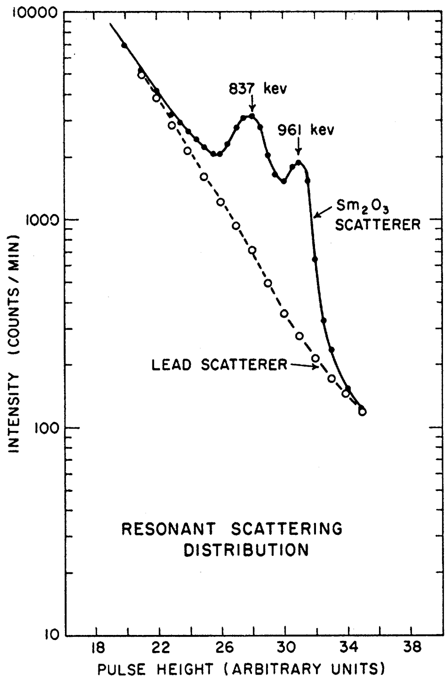

FIG. 2. Resonant scattering distribution from a scatterer of $\sim$1850 g of Sm_2O_3.

first approximation. The resonant scattered gamma-ray distribution is shown in Fig. 2 for a source strength of $\sim$20 millicuries. The ratio of the 837-kev to 961-kev photopeaks is 1.8 which is in agreement with the ratio of the γ rays before scattering, 1.4, corrected for detection efficiencies and for the different angular distributions of the scattered gamma rays at 100°—the mean angle of scattering. The cross section measured with the solid source is $(5\pm1)\times10^{-26}$ cm^2, the major uncertainties being in the geometry and source strength determinations. The liquid source gave a 20% higher cross section; the difference may be due to a slowing down of the recoiling nucleus in the solid or a change in its effective mass.

In order to calculate the lifetime of the transition one should take into account the natural width of the emitting level, the Doppler broadening of the emitted gamma ray due to the neutrino recoil, the possible slowing down of the recoiling nucleus, the effective mass, and the temperature broadening of the emission and absorption lines. If the recoil and temperature effects are neglected, a lower limit on the mean life can be set as 1.7×10^{-14} sec. An upper limit is certainly the slowing-down time in the solid, approximately 2×10^{-13} sec,[7] since a stationary nucleus with a level of this mean life will give a cross section less than 1/100 that observed. Conversely, therefore, the gamma ray is emitted in general before the recoil slows down so that the Doppler broadening due to the neutrino emission must be taken into account, and the resonance scattering becomes a sensitive detector of the direction of neutrino emission. Taking into account the width of the emitting line and the Doppler shift due to the recoiling nucleus, assumed to have an effective mass number equal to 152, the mean life of the 1^- level becomes $\tau=(3\pm1)\times10^{-14}$ sec. The effect of the temperature of the source and scatterer has been neglected. The measured lifetime is thus approximately 150 times longer than the single proton estimate. This mean life corresponds, according to the formulation of Bohr and Mottelson,[8] to an octupole deformation parameter, $\beta_3\simeq0.07$, for the 1^- state of Sm^{152}.

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Helicity of Neutrinos*

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A COMBINED analysis of circular polarization and resonant scattering of γ rays following orbital electron capture measures the helicity of the neutrino. We have carried out such a measurement with Eu^{152m}, which decays by orbital electron capture. If we assume the most plausible spin-parity assignment for this isomer compatible with its decay scheme,[1] $0-$, we find that the neutrino is "left-handed," i.e., $\boldsymbol{\sigma}_\nu\cdot\hat{\mathbf{p}}_\nu=-1$ (negative helicity).

Our method may be illustrated by the following simple example: take a nucleus A (spin $I=0$) which decays by allowed orbital electron capture, to an excited state of a nucleus $B(I=1)$, from which a γ ray is emitted to the ground state of $B(I=0)$. The conditions necessary for resonant scattering are best fulfilled for those γ rays which are emitted opposite to the neutrino, which have an energy comparable to that of the neutrino, and which are emitted before the recoil energy is lost. Since the orbital electrons captured by a nucleus are almost entirely s electrons (K, L_{I}, $\cdots$ electrons of spin $S=\frac{1}{2}$), the substates of the daughter nucleus