Energy Levels of Pt^{197}

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(Z. Naturforsch. **29 a**, 1917–1918 [1974]; received September 9, 1974)

Spectra of γ rays (higher than 0.3 MeV) following the β decay of Ir^{197} are measured with a Ge-Li detector (30 cm^3). The existence of four new branches to the Pt^{197} levels at 877.6 ± 0.3; 939.7 ± 0.3; 1049.6 ± 0.3; 1341.8 ± 0.3 keV is proposed and lower limit $\log ft$ values are determined. Spin and parity $(1/2, 3/2)^+$ are assigned to the ground state of Ir^{197}.

A new transition of 299.5 ± 0.2 keV was observed following the Pt^{197} (80 min) decay.

Introduction

The Pt^{197} nucleus is situated in a transitional region. So, changes between spherical and deformed shapes can be expected to happen. A good understanding of the nuclear structure of this nucleus would be very interesting, but previous experimental information has been rather sparse. It are summarized in the compilation [1].

The present study was undertaken with the hope to obtain data on Pt^{197} nuclear levels which could help the development of a more satisfactory theory of "nearly spherical" even odd nuclei.

Experimental Technique

Natural Platinum was irradiated in the Bremsstrahlung beam of a linear accelerator at 28 MeV producing Ir^{197} by (γ, p) reactions. States in Pt^{197} were accessible from the decay or Ir^{197} whose disintegration energy is 2 MeV [2]. The main disadvantage of this method is that below 300 keV it becomes very difficult to distinguish γ rays corresponding to transitions in Pt^{197}. There is in this region a strong contribution of other nuclei also formed.

A special search was then performed for weak lines above 300 keV, and 3 mm Pb and Cu absorbers were introduced in order to decrease the strong low energy background. Measurements of gamma-ray spectra were carried out and energies, intensities, and half-lifes determined.

Results

Figure 1 illustrates one of the gamma-ray spectra from Ir^{197} decay. Four weak lines unrecorded previously and with half-lives in strict similarity to that of the Ir^{197} ground state are found. In several runs performed in order to check our results, the new gamma-ray values were systematically consistent. Lower limit log ft values could be estimated from our results and from β spectroscopy data [4].

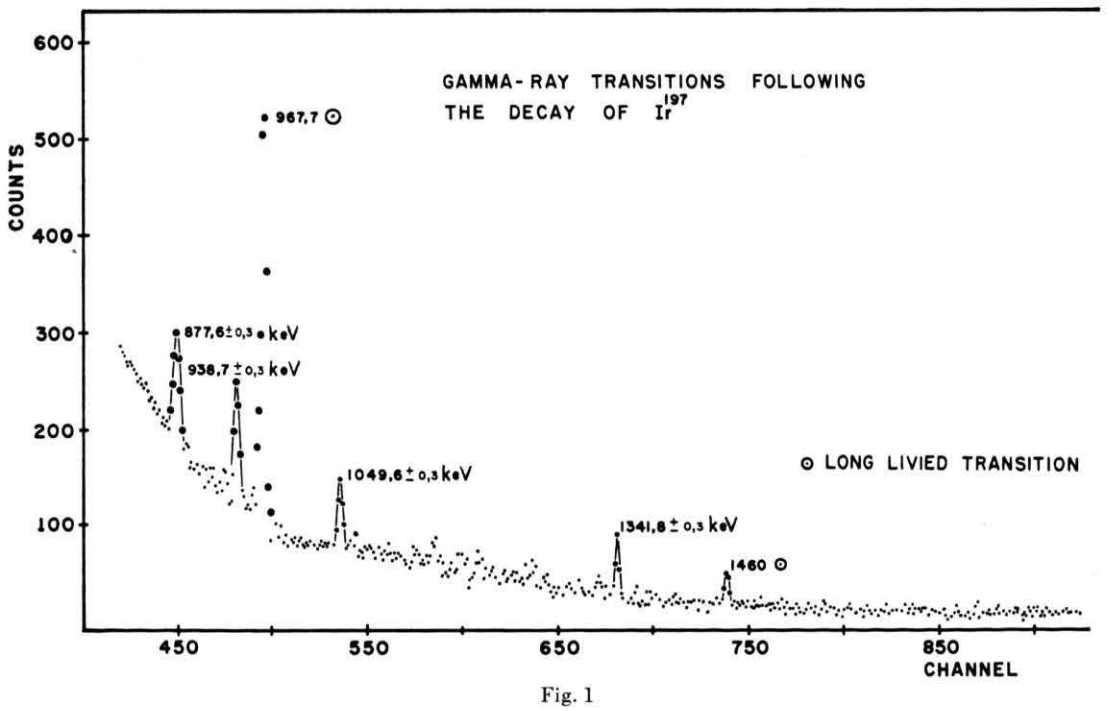

Fig. 1

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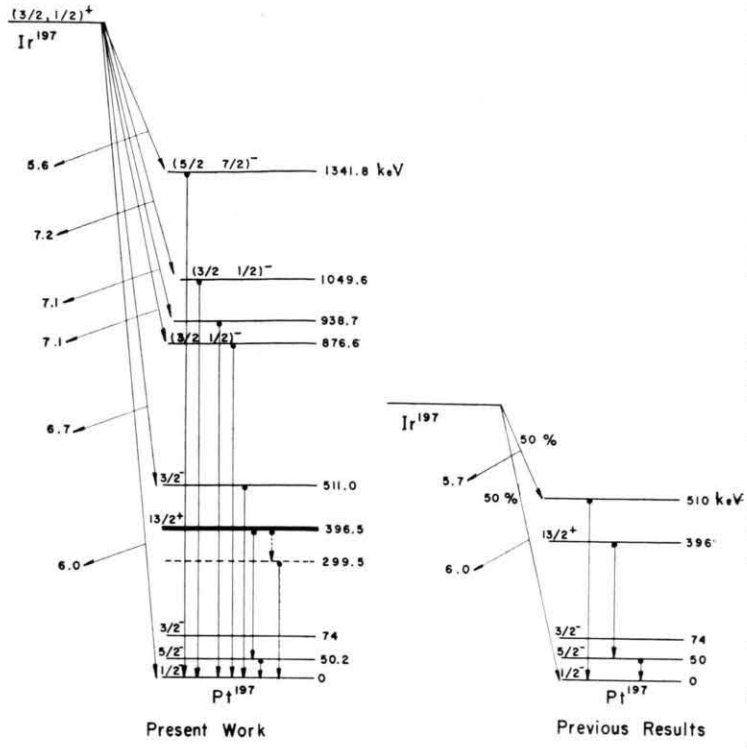

Fig. 2

Table 1. Gamma transitions following the β decay of Ir^{197} and log ft values to the levels of Pt^{197}.

Energy (keV)	Relative intensity	log ft
511,0 ± 0,2	100	6,7
877,6 ± 0,2	0,8 ± 0,1	7,1
938,7 ± 0,3	0,9 ± 0,1	7,1
1049,6 ± 0,3	0,51 ± 0,05	7,2
1341,8 ± 0,3	0,45 ± 0,05	5,6

Table 2. Energy levels (keV) of Pt^{197}.

Our work $Ir^{197}\beta^- \rightarrow Pt^{197}$	Mukerjee [4] Pt^{196}(d,p) Pt^{197}	Mukerjee [4] Pt^{198}(d,t) Pt^{197}	Samour [5] Pt^{196}(n,γ) Pt^{197}
877,6 ± 0,3	880 ± 20	880 ± 20	—
938,7 ± 0,3	—	—	965 ± 30
1049,6 ± 0,3	1070 ± 20	1050 ± 20	1076 ± 30
1341,8 ± 0,3	—	1320 ± 20	—

Table 3. Gamma transitions following the decay of Pt^{197m}.

Our work energy (keV)	Our work relative intensity	Haverfield et al. [6] energy (keV)	Haverfield et al. [6] relative intensity
346,5 ± 0,2	100	346	100
279,1 ± 0,2	21 ± 2	279	21 ± 2
299,5 ± 0,2	0,9 ± 0,1	—	—

Table 1 lists energies, intensities, and lower limit log ft values for the proposed β branches. The resulting spin and parity assignments are in complete agreement with nuclear reaction data [4, 5] if the ground state spin of Ir^{197} is assumed to be $1/2^+$ or $3/2^+$.

In Table 2 we summarize the experimental information available, concerning the Pt^{197} energy levels, from our work and (d, p) [4], (d, t) [4] and (n, γ) [5] experiments. As a whole, the set of levels is in good agreement.

With respect to transitions following the Pt^{197} (80 min) decay, also analysed in the present work, a new transition of 299.5 ± 0.2 keV was observed. It can be interpreted as arising from the level 280 ± 20 keV detected by Mukherjee [4].

Discussion

All the gamma-rays observed in our measurements are positionned in a tentative decay scheme shown in comparison with previous results [6] in Figure 2.

The ground state spin proposed according to our log ft values is in conformity with results of all other measured nuclei with $Z = 77$ (Ir^{191}, Ir^{193}) [7] and $Z = 79$ (Au^{197}, Au^{199}) [6, 7].

[1] M. B. Lewis, Nucl. Data. Sheets, **B 7**, 129 [1972]; reference list.
[2] A. H. Wapstra and N. B. Goue, Nucl. Data. Tables, **A 9**, 303 [1971].
[3] S. Homma, T. Kuroyanagi, and H. Morinaga, J. Phys. Soc. Japan **16**, 841 [1961].
[4] P. Mukherjee, Nucl. Phys. **64**, 65 [1965].
[5] C. Samour, Partial Radiative Capture of Resonance Neutrons, Saclay, Comissariat d'Energie Atomique, 1969 (CEA-R-3776).
[6] A. J. Haverfield, H. T. Easterday, and J. M. Hollander, Nucl. Phys. **64**, 379 [1965].
[7] G. H. Fuller and V. W. Cohen, Nucl. Data. Tables **A 5**, 433 [1969].