β^+ / EC DECAY OF ^{181}Au : γ - RAY IDENTIFICATION

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ABTRACT — The β+/EC decay of ^{181}Au has been studied with mass separated sources from the ISOCELE facility. Main γ-rays which belong to the ^{181}Au $\rightarrow$ ^{181}Pt decay have been identified from X-γ coincidence measurements. A rotational band built on the 1/2− [521] Nilsson state has been developed up to the 7/2− state in ^{181}Pt.

1 — INTRODUCTION

The nuclei of platinum have been studied extensively [1-8] and a shape transition has been found for A = 186. ^{185}Pt corresponds indeed to a prolate-shaped nucleus, whereas ^{187}Pt seems to correspond to an oblate-shaped one. However some phenomena observed in this transitional region are not yet well understood: the existence of highly converted transitions in ^{187}Pt [8], ^{187}Au [9], ^{185}Au [10, 11], $^{193, 195, 197}$Hg [12, 13] for example. So we have extended the study of the platinum nuclei down to the very neutron-deficient isotopes. The present work is the first step of the study of the β^+ / EC decay of ^{181}Au. Gold isotopes were produced by Pt (p,xn) Au reactions, then mass-separated using the ISOCELE II facility at Orsay. X - γ coincidence measure-

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ments allowed us to clearly attribute twenty four γ - rays to the $^{181}Au \rightarrow {}^{181}Pt$ decay.

Such results can also be very useful to identify the ^{181}Au or ^{181}Pt nuclei produced by (HI,xn) reactions.

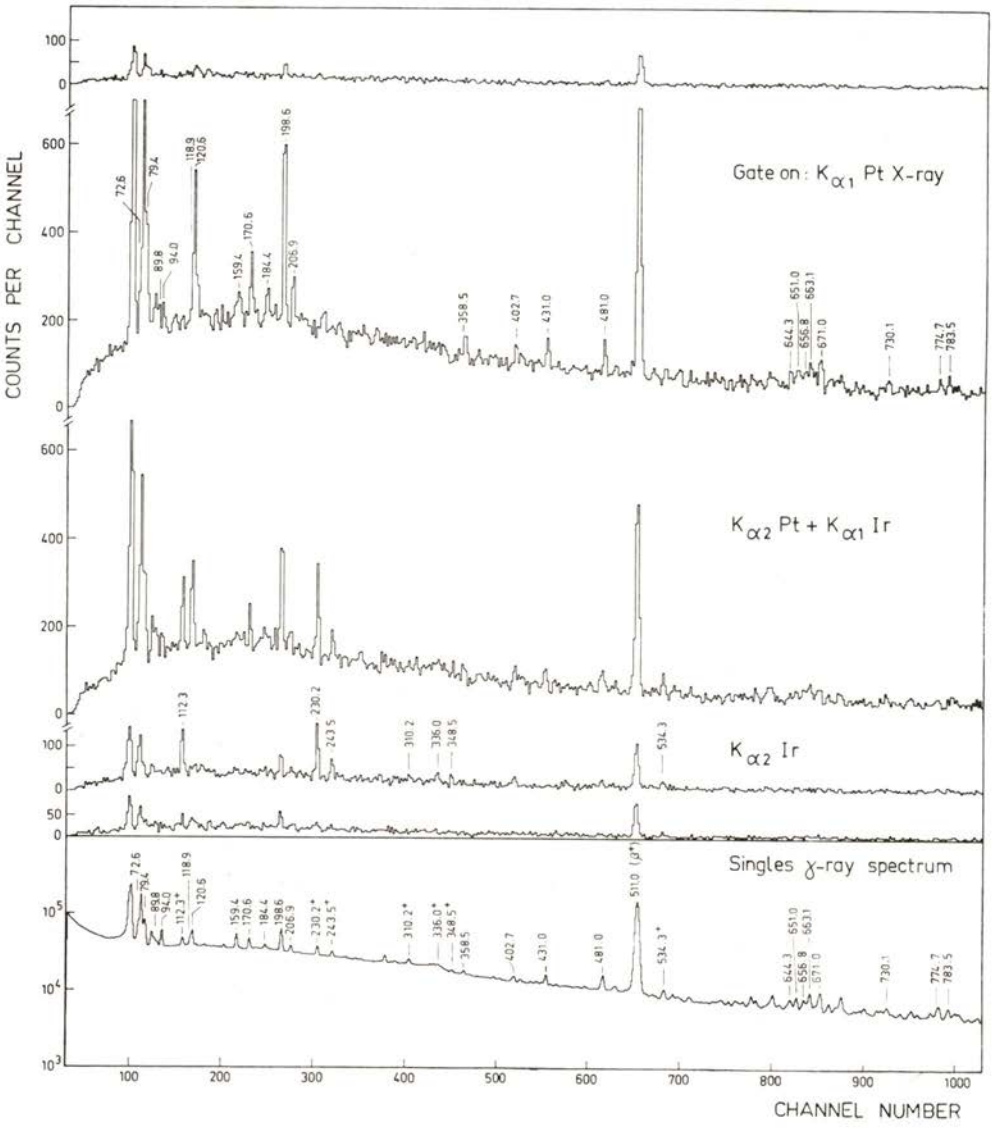

Fig. 1 — Coincidence spectra (2 keV gates from 60 to 70 keV) and singles γ-ray spectrum. + indicates γ-lines which belong to the $^{181}Pt \rightarrow {}^{181}Ir$ decay.

2 — EXPERIMENTAL PROCEDURE

A thick target of molten Pt - β alloy was bombarded by a 200 MeV proton beam from the Orsay synchrocyclotron in order to produce gold nuclei via Pt (p,xn) Au reactions.

The proton beam intensity was 2.5 μA . The target was placed inside the high-temperature ion source [14] of the ISOCELE II isotope separator [15]. The mass-separated gold ions were collected on a mylar / aluminium tape and then carried to the counting station using a fast mechanical tape-transport system.

Singles gamma - rays were measured with a planar Ge (HP) X - ray detector (0.6 keV FWHM resolution at 122 keV) and a 12 % efficiency coaxial Ge (HP) detector (2 keV FWHM resolution at 1.33 MeV). The energy ranges were from 4 keV to 400 keV and from 30 keV to 1500 keV respectively. The X - γ - t coincidence data were simultaneously recorded event by event on magnetic tapes. The experimental data were analysed off-line on the Orsay IBM 138-370 computer. The coincidence events have been treated in order to get prompt coincidence bidimensional matrix. The coincidence spectra shown in Fig. 1 were obtained by setting 2 keV gates on K_α X - rays e.g. from 60 to 70 keV. Collecting and counting times were 5 s per source and the data were accumulated for ten hours.

3 — EXPERIMENTAL RESULTS AND DISCUSSION

Energies and intensities of γ - rays deduced from the γ and X spectra are listed in table 1 together with the coincidence results. Twenty three γ - rays can be clearly ascribed to the $^{181}Au \rightarrow {}^{181}Pt$ decay.

In spite of lack of intensity for the 159.4 keV γ - line observed in coincidence with K_α X - rays of Pt (see Fig. 1), we can attribute this transition to the $^{181}Au \rightarrow {}^{181}Pt$ decay because the 40.5 keV γ - line has been observed in coincidence with the 118.9 keV γ - line and the sum 40.5 + 118.9 corresponds to 159.4 keV. This fact suggests a rather long lifetime for the state which decays by both the 159.4 keV transition and the 40.5 - 118.9 keV cascade.

TABLE 1—Gamma-ray data for the decay of ^{181}Au (collecting and counting times, for ^{181}Au sources, were 5 s): energy error $\leqslant$ 0.3 keV; intensity error ~ 10%.

Energy (keV)	I_γ relative	Main coincidences		Energy (keV)	I_γ relative	Main coincidences	
		K_α X-rays	γ-rays			K_α X-rays	γ-rays
40.5	15	Pt	118.9	402.7	15	Pt	
49.9	23	Pt	120.6	431.0	45	Pt	
			431.0	481.0	74	Pt	
72.6	~ 15	Pt	120.6	491.8	23		
79.4	84	Pt	198.6	534.3	42	Ir	
87.7	10			542.3	24		
89,8	13	Pt		556.4	20		
94.0	56	Pt		591.4	14		
112.3	23	Ir	230.2	611.0	41		
118.9	23	Pt	40.5	615.2	27		
120.6	43	Pt	49.9	629.3	58		
148.6	10			644.3	40	Pt	
159.4	55	(Pt)		651.0	44	Pt	
170.6	38	Pt		656.8	48	(Pt)	
184.4	19	Pt	94.0	663.1	72	Pt	
198.6	100	Pt	79.4	671.0	84	Pt	
206.9	26	Pt		679.0	29		
230.2	36	Ir	112.3	689.7	72		
243.5	24	Ir		710.1	29		
289.4	35			721.0	20		
310.2	23	Ir		730.1	23	Pt	
328.9	4			750.6	29		
332.3	6			756.4	15		
336.0	6	Ir		767.6	26		
348.5	8	Ir		774.7	61	Pt	
358.5	13	Pt		783.5	48	Pt	

The studies of the α decay of the mercury isotopes allowed E. Hagberg et al. [16] to propose level schemes for $^{177, 179, 181}$Pt and to identify the $1/2^-$ [521] state and the $3/2^-$, $5/2^-$ rotational states built on it. Recently we have studied the β^+/EC decay of ^{185}Au [17] and ^{183}Au [18], and identified the $1/2^-$ [521] rotational band built on the isomeric state of ^{185}Pt and on the

ground state of ^{183}Pt. The results obtained in the present work support the previous identification of the 5/2, 3/2, and 1/2 states of the $1/2^-$ [521] band in ^{181}Pt and allow us to propose the additional 7/2 $1/2^-$ [521] state. The systematic of the $1/2^-$ [521]

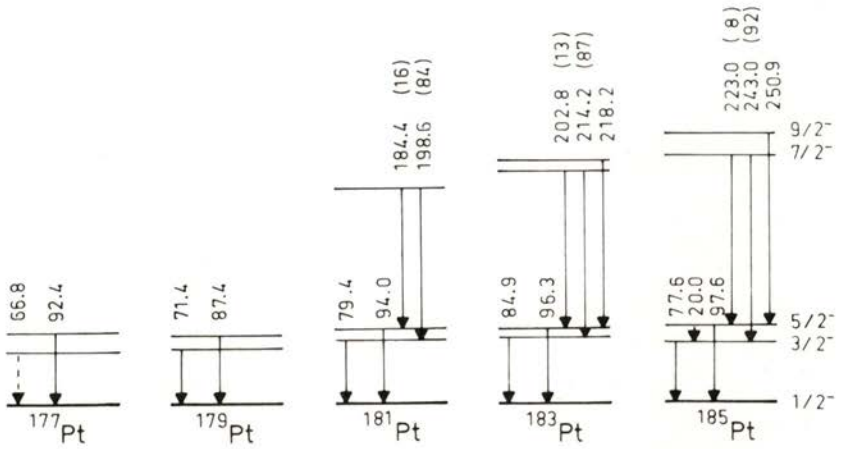

Fig. 2 — The systematic of the rotational band built on the $1/2^-$ [521] state. Data were taken from ref. 16 ($^{177,179,181}Pt$), this work (^{181}Pt), ref. 18 (^{183}Pt), and ref. 17 (^{185}Pt). Dashed line indicates transition not observed experimentally. Numbers in parentheses are γ-line intensities.

rotational band through the platinum isotopes is shown in Fig. 2. The stability observed indicates clearly that all the $^{177-185}Pt$ isotopes correspond to prolate-shaped nuclei contrary to the heavier platinum isotopes.

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