SHAPE TRANSITION BETWEEN ^{187}Pt AND ^{185}Pt

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INTRODUCTION.

Results obtained using the ^{174,176}Yb(^{16}O,5n) reactions at the Orsay variable energy cyclotron [1,2] have shown in ^{187}Pt a decoupled band probably built on the $13/2^+$ state and in ^{185}Pt a normal band on the $9/2^+$ state which indicates a transition from an oblate shape in ^{187}Pt to a prolate one in ^{185}Pt ; this may be compared with the oblate-prolate shape transition occuring between ^{188}Pt and ^{186}Pt [3]. Simultaneously, ^{185,187}Pt nuclei were studied by radioactive decay from Au using the mass separator ISOCELE on line with the Orsay synchrocyclotron. Preliminary results on the ^{187}Pt level scheme were given at the SFP conference [2] ; further experiments at ISOLDE-CERN allow now to give more data on ^{187}Pt and to present the level scheme of ^{185}Pt.

EXPERIMENTAL PROCEDURES.

γ-γ coincidences and e^--γ multipolemeter data were recorded at the ISOCELE facility (the gold activity was obtained either by Au(p,xn)Hg→ Au or by PtB(p,xn)Au reactions) ; electron detection was improved by use of a magnetic selector [4]. A double lens magnetic spectrometer [5] was used at Orsay and CERN for e^--γ, e^--e^- coincidences and lifetime measurements.

The conversion electron lines of ^{187}Au decay were detected off-line at ISOLDE with better resolution by use of a 180° flat spectrograph (fig.1).

EXPERIMENTAL RESULTS.

+ The decay of ^{187}Au ($T1/2 \simeq 8$ mn) : the level scheme of ^{187}Pt is given on fig.2. The ground state spin has been found by H. RUBINSZTEIN et al.[6], to be $3/2^-$ in an experiment using ABMR method; other spin assignments are supported by transition multipolarity measurements. The M2 character of the 260 keV transition ($\alpha_K = 1.2 \pm .4$) and the coincidences of the K 260 electron line with the 247 and 834 keV γ transitions indicate a $7/2^+$ level at 260 keV.

The P(E2) and P(M1) values presented in Table I have been calculated using the low energy transition multipolarities determined by the electron results

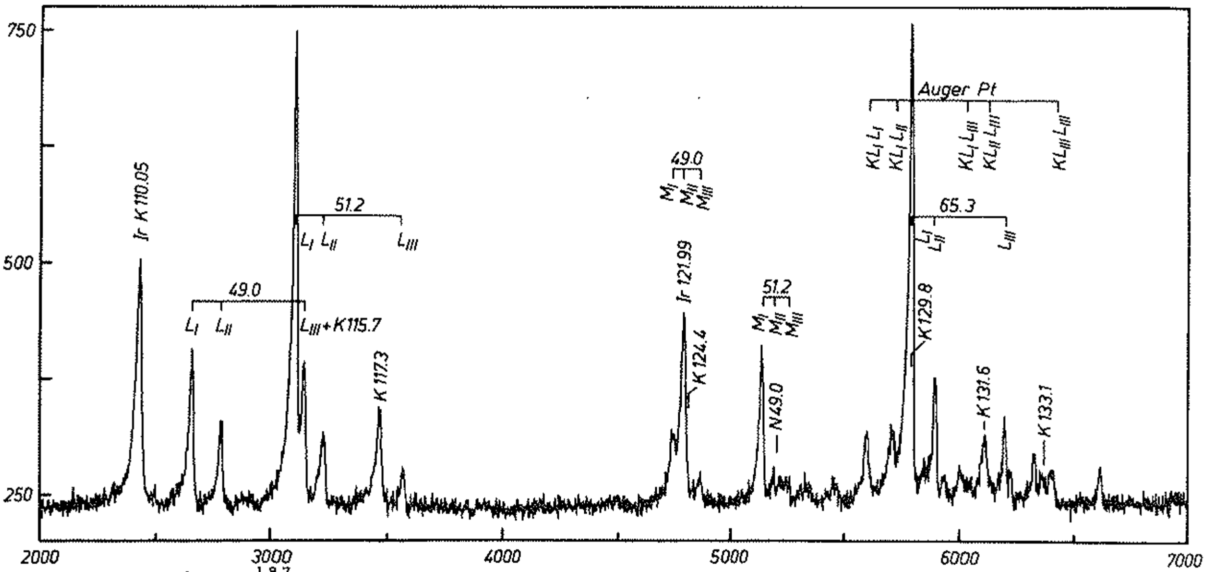

Fig.1. ^{187}Au → Pt : partial microdensitogram of the photographic plate obtained with the 180° spectrometer.

[1] radioactivity studies
[2] (HI,xn) reaction studies

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E_{Level} (keV)	$T^{exp}_{1/2}$ (ns)	E_γ (keV)	Multipolarity	P_{exp} [a]	P_{sp} [a,b]	F_{sp} [a,c]
25.6	0.7	25.6	M1 E2 (0.4%)	1.2 (7) 4.8 (4)	4.9 (8) 8.8 (2)	40 1.8 (-2)
51.2	0.3	51.2	M1 E2 (0.8%)	2.3 (8) 1.8 (6)	3.9 (9) 2.8 (4)	17 1.5 (-2)
57.2	20	31.6	M1	9.5 (5)	9.2 (8)	970
74.6	0.5	49.0	M1 E2 (5.7%)	2.0 (7) 1.2 (6)	3.4 (7) 2.3 (4)	1.7 1.8 (-2)
		65.3	M1 E2 (2.5%)	1.5 (8) 3.7 (6)	8.1 (7) 9.5 (4)	0.6 2.5 (-2)
		74.5	M1 E2 (2%)	4.1 (7) 8.4 (5)	1.2 (8) 1.8 (5)	2.9 0.2

Table 1. Experimental lifetimes and hindrance factors for gamma ray transitions between low lying states of ^{187}Pt.

a) The number in parenthesis means the power of 10.

b) The theoretical single-particle transition probabilities are obtained by :

$$P_{sp}(M1) = 2.9\ 10^{13}\ E_\gamma^{\ 3}\ (\text{MeV})$$

$$P_{sp}(E2) = 7.47\ 10^{7}\ A^{4/3}\ E_\gamma^{\ 5}\ (\text{MeV})$$

c) $F_{sp} = \dfrac{P_{sp}}{P_{exp}}$

obtained with the flat spectrometer and the lifetime measurements.

+ The decay of ^{185}Au (T1/2 ≃ 4 mn) : we may construct two level sequences rather independent, one of them built on the high spin positive parity system already seen in (HI,xn) reaction, and the other on a low spin state (fig.3).

The decay of ^{185}Pt produced at the Orsay Tandem accelerator by ^{177}Yb(^{16}O,5n) feeds the high spin states of ^{185}Ir [7] with a period T1/2 = 70 mn : this result confirms the assumption of a 9/2$^+$ band head for the high spin system in ^{185}Pt. A low spin isomeric state is suggested since the low spin states of ^{185}Ir are fed with the period of T1/2 = 30 mn : this state is tentatively put at 129 keV.

DISCUSSION.

+ The ^{185}Pt nucleus : the rotational band 9/2$^+$ [624] in the nuclei (N = 107, Z ⩽ 78) exhibits a strong coupling pattern which indicates a well deformed prolate shape ; we may note that the Coriolis perturbation seems to increase with Z (fig.4).

The N = 107 single particle state systematics presented on fig.5 suggest that

i) the isomeric state in ^{185}Pt, tentatively placed at 129 keV, is the 1/2$^-$ [521] state and the 226.7 keV level the 5/2 1/2$^-$ [521] rotational state : the energy of the transition 5/2$^-$ → 1/2$^-$ (97.7 keV) is very similar to those of ^{181}Os (102.7 keV), ^{179}W (96.7 keV) and ^{181}W (103 keV) [8,9,10].

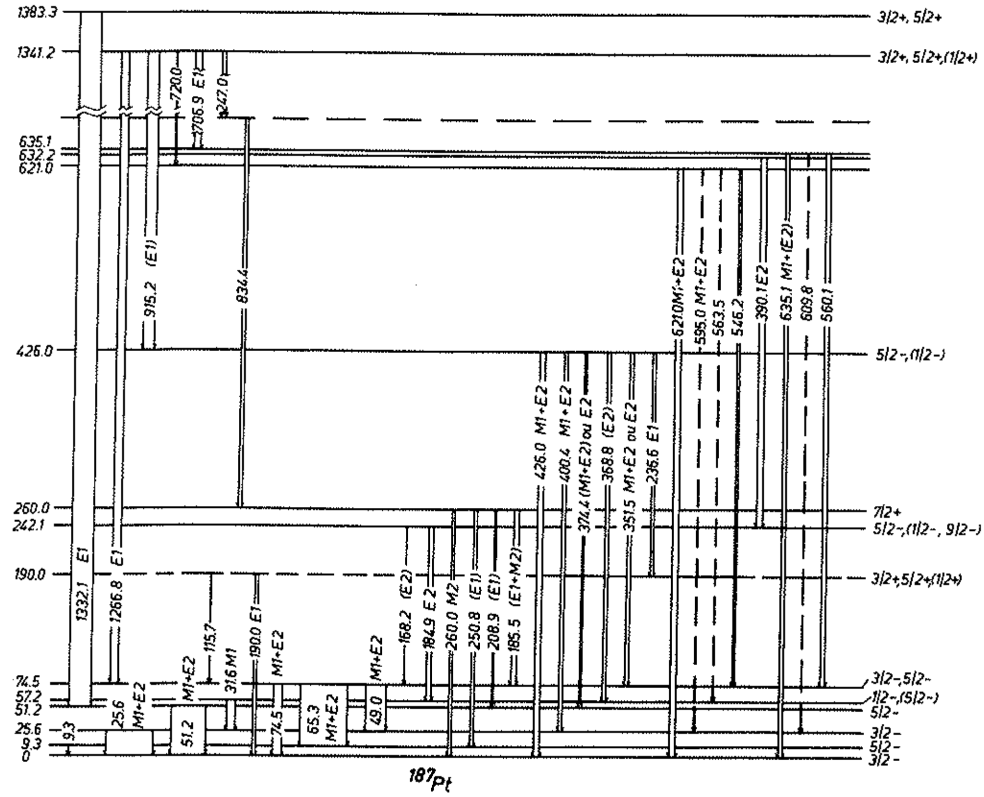

Fig.2. ^{187}Pt level scheme obtained by radioactivity.

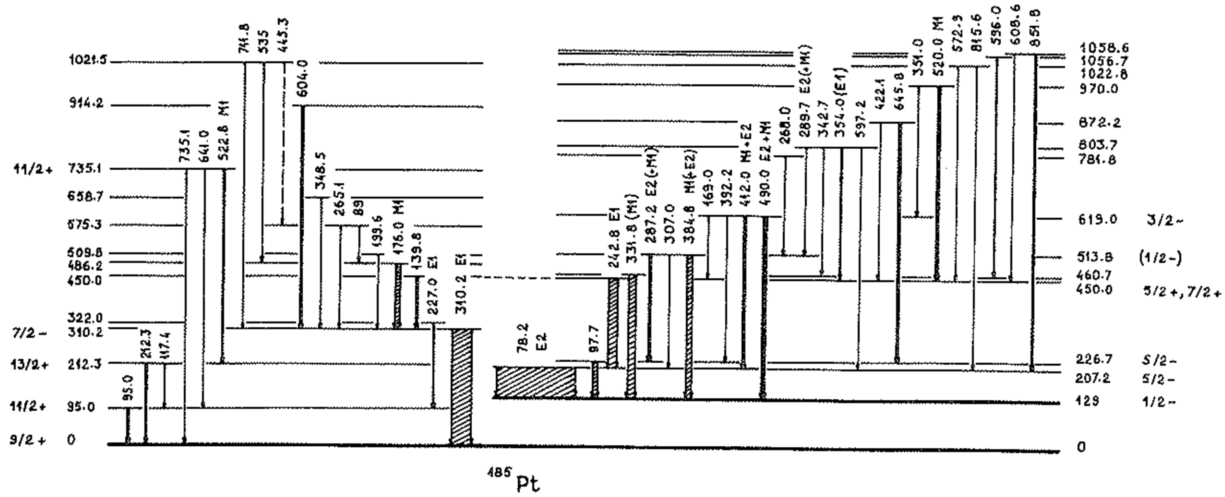

Fig.3. ^{185}Pt level scheme obtained by radioactivity : the $1/2^+$ isomeric state is tentatively placed at 129keV.

ii) the states at 207.2 keV, 513.8 keV and 619 keV may be respectively the $5/2^-$ [512], $1/2^-$ [510] and $3/2^-$ [512] states.

+ The ^{187}Pt nucleus : On the fig.5, the experimental decoupled $13/2^+$ band [1] is compared to the level system expected from coupling an i13/2 neutron hole to a triaxial rotating core [11]. A rather good agreement is found for an asymmetry parameter γ=35°.

The unfavoured antialigned 7/2+ state observed at 305 keV above the 13/2+ level in ^{191}Pt [12] decays towards a 11/2+ level ; the 7/2+ state at 260 keV in ^{187}Pt has a different decay mode and seems rather low to be such a state.

No member of the $13/2^+$ system is seen in radioactivity ; this may be explained by the internal transition of the high spin isomeric state of ^{187}Au [13] contrary to the heavier odd-mass gold isotopes.

About the low lying states of ^{187}Pt, we may see in Table 1 that :

i) there is no pure E2 transitions between these states ;

ii) the 25.6, 51.2, 49.0 and 65.3 keV transitions are enhanced relative to the single-particle E2 estimates indicating a collective character.

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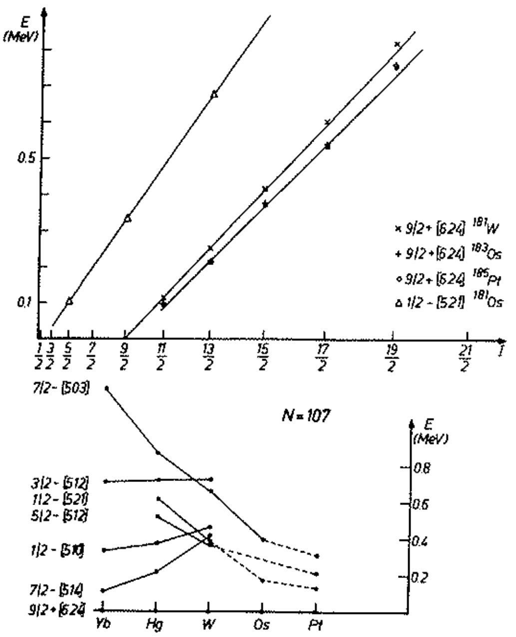

Fig.4. Up : behaviour of some rotational bands in N = 107-105.
Down : systematics of Nilsson single-particle state in the N=107 isotones.

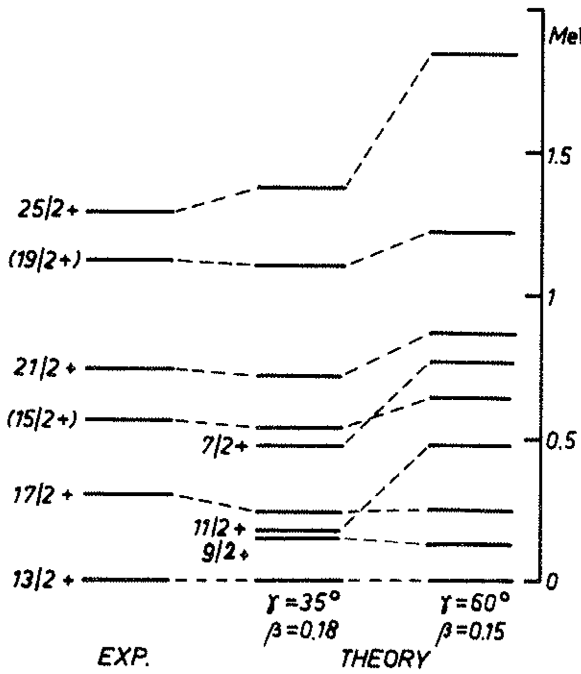

Fig.5. ^{187}Pt : comparaison of experimental and theoretical energies of decoupled $13/2^+$ band. Parameters used in the calculation are λ_F=-1.5, Δ=0.7 MeV (these parameters are defined in ref.[11]).

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