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STUDY OF ^{188}Pt WITH THE ^{190}Pt(p, t)^{188}Pt REACTION

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Résumé. — La réaction ^{190}Pt(p, t)^{188}Pt a été étudiée à 25 MeV sur une cible enrichie (35 %). L'intensité de la transition fondamental → fondamental ne diffère pas, dans la limite des erreurs, de celles observées pour les autres isotopes pairs du Pt et le premier état O^+ est faiblement excité (5 %) par rapport au fondamental. Il n'y a donc aucune indication d'un changement de forme important entre 190 et 188.

Abstract. — The ^{190}Pt(p, t)^{188}Pt reaction has been studied at 25 MeV on an enriched target (35 %). The g.s. → g.s. intensity does not differ — within the error limits — from those observed for the other even Pt isotopes and the low-lying O^+ level is weakly excited (5 %) as compared with the ground state. There is therefore, no indication of an important shape transition between 190 and 188.

1. **Introduction.** — Kumar and Baranger [1] long ago predicted the occurrence of an oblate to prolate shape transition in platinum when going from the heavy to the light isotopes. Kumar, in more recent calculations [2], concludes that ^{196}Pt and ^{192}Pt are oblate and ^{186}Pt prolate, the shape transition occurring between ^{192}Pt and ^{186}Pt. Another calculation, by Götz *et al.* [3], predicts the transition as occurring between $A = 192$ and $A = 190$.

The (p, t) reaction has proved [4, 5] to be quite sensitive to shape transitions : when crossing such a transition there is an appreciable reduction of the ground state to ground state transition strength (reduced overlap) the missing strength corresponding to the observed important population of a low-lying O^+ level which is described as a shape isomer. The (p, t) reaction has already been studied [6] on ^{196,194,192}Pt targets. We describe in the present paper the result of the (p, t) reaction on the rare target ^{190}Pt.

2. **Study of the (p, t) reaction.** — The (p, t) reaction has been studied using a 25 MeV proton beam from the Orsay MP tandem and a split pole magnetic spectrometer. The enriched Pt was produced at the Orsay C.S.N.S.M. isotope separator SIDONIE. A target was prepared by depositing and drying a droplet of chlorhydrate solution on a 50 μg/cm^2 carbon backing. The Pt thickness of the target was of the order of 70 μg/cm^2. The resolution was 35 keV (F.W.H.M.) and the peak shapes quite asymmetrical, due to evident target inhomogeneities.

The peak corresponding to the ^{188}Pt$_{g.s.}$ is clearly identified in the spectra and the corresponding angular distribution has a standard $L = 0$ shape (Fig. 1). The corresponding experimental Q value is determined as $Q = -7\,150 \pm 10$ keV to be compared to the Wapstra and Bos [7] value $Q = -7\,193 \pm 23$ keV. The presence of an important background due to the (p, t) reaction on all the other Pt isotopes and impurities present in the target makes it very difficult with the relatively poor resolution of the present experiment to extract the angular distributions of excited states of ^{188}Pt. It has however been possible to extract the angular distribution of the first excited O_2^+ level at 800 keV. Its shape is compared to that of the ground state in figure 1. The ratio

$$R = \sigma(O_2^+)/\sigma(O_{g.s.}^+)$$

is 5 %. As we shall see later another O^+ level has been observed in the heavier Pt isotopes around 1.6 MeV. In ^{188}Pt we have been able to put a firm limit, $R \leqslant 2$ %, for any O^+ level in the excitation range between 1.5 and 2 MeV.

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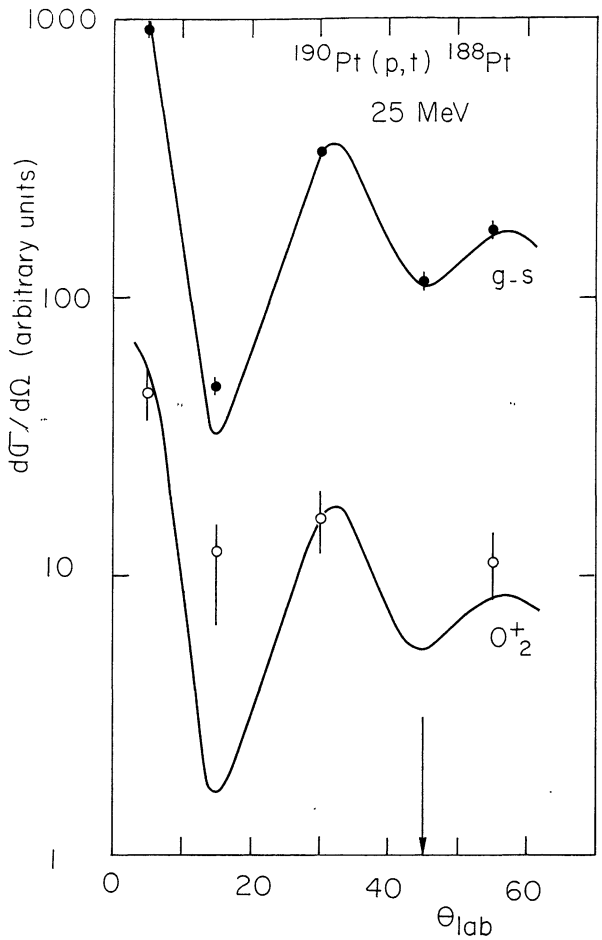

FIG. 1. — Experimental angular distributions of the tritons in the ^{190}Pt(p, t)^{188}Pt reaction, for the ground state and the first excited 0^+ level. The curves represent the average shape of the angular distributions (all practically identical) measured in the present experiment for all the g.s. → g.s. transitions of the heavier Pt isotopes. The vertical bars correspond only to the statistical uncertainties. For the excited 0^+ level an additional source of uncertainty, except for the point at $\theta_{lab} = 5°$, may be due to the estimate of the substracted background.

3. **Isotopic composition of the target.** — The enrichment of ^{190}Pt in the platinum used to prepare the target was unknown. A direct comparison of the intensities on the g.s. → g.s. transitions (for each isotope) in the (p, t) reaction on respectively the enriched and a natural Pt target gave the relative proportions of the ^{192,194,195,196,198}Pt isotopes in the target. However, due to the rarity of ^{190}Pt in the natural Pt (0.012 7 %) the g.s. → g.s. transition is not observed. It was therefore necessary to determine the relative amount of ^{190}Pt as compared with one of the other isotopes.

The measurement was performed by activation analysis. The material of the target and a sample of natural Pt were irradiated together during 3 days in a thermal neutron flux of 10^{12} n/cm^2/s. The observation and intensity measurement, using Ge(Li) detectors, of the 539 keV γ ray emitted in the decay of ^{191}Pt (3 days) permitted determination of the relative amount of ^{190}Pt in the two samples. A chemical separation of gold from platinum was then performed and the intensity measurement of the 158 keV γ ray emitted in the decay of ^{199}Au (3.15 days) permitted determination of the relative amount of ^{198}Pt in the two samples.

Using both the activation and the (p, t) results, it is possible to determine the composition of the target given in table I. The abundance of ^{190}Pt is 35 ± 3.5 %. From these results the g.s. → g.s. relative intensities can be determined.

TABLE I

Isotopic composition of the target (%)

190	192	194	195	196	198	*A*
34.9	0.65	26.8	20.4	14.6	2.6	Target
0.012 7	0.78	32.9	33.8	25.3	7.22	Nat. Pt

4. **Discussion.** — The relative g.s. → g.s. intensities for all the stable Pt targets, normalized to 100 for the ^{194}Pt$_{g.s.}$ → ^{192}Pt$_{g.s.}$ transition, are compared in table II. It is clear that no important variation is observed although there is possibly an indication of a slight increase for the two lighter targets. This result, as well as the small relative value (5 %) of the population of the first low-lying 0^+ level, indicates that no significant shape transition occurs between $A = 190$ and $A = 188$, so that ^{188}Pt has a shape similar to that of the heavier Pt isotopes. If there is a shape transition, it should therefore occur between $A = 188$ and $A = 186$. This is in agreement with the striking discontinuity observed at this place in the VMI treatment [8] of the experimental energies and with the shape transition observed recently [9] for the odd isotopes between ^{187}Pt and ^{185}Pt.

Besides the low-lying first 0^+ level, interpreted by us [10] as corresponding mainly to a two phonons γ vibration, another higher-lying 0^+ level has been observed [6, 10] in ^{194,192,190}Pt, its population being of the order of 6 % of the ground state one and its energy being practically the same in the 3 isotopes (respectively 1 546, 1 617 and 1 670 keV). It is clear, from the limit we have been able to fix for any 0^+ level in ^{188}Pt between 1.5 and 2 MeV ($R \leqslant 2$ %), that the population of this level drops significantly in ^{188}Pt. Such an effect, as well as the similar ground state to ground state intensities observed in the present experiment for all the Pt targets, is correctly predicted by Iachello and Scholten [11] in the interacting bosons model of the Pt nuclei.

TABLE II

Ground state to ground state transition strengths

188 ← 190	← 192	← 194	← 196	← 198
111 ± 21	111 ± 11	100	96.8 ± 2	98.5 ± 4

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References

[1] KUMAR, K. and BARANGER, M., *Nucl. Phys.* **A 122** (1968) 273.

[2] KUMAR, K., *Proceedings of Conf. on properties of nuclei far from stability*, Leysin CERN Report 1970 (70-30), p. 779.

[3] GÖTZ, U., PAULI, H. C., ALDER, K., JUNKER, K., *Nucl. Phys.* **A 192** (1972) 1.

[4] HINDS, S., BJERREGAARD, J. H., HANSEN, O. and NATHAN, O., *Phys. Lett.* **14** (1965) 48.
BJERREGAARD, J. H., HANSEN, O. and NATHAN, O., *Nucl. Phys.* **86** (1966) 145.
MAXWELL, J. R., REYNOLDS, G. M. and HINTZ, N. M., *Phys. Rev.* **151** (1966) 1000.
DEBENHAM, P. and HINTZ, N. M., *Phys. Rev. Lett.* **25** (1970) 44.

[5] VERGNES, M. N., ROTBARD, G., GUILBAUT, F., ARDOUIN, D., LEBRUN, C., FLYNN, E. R., HANSEN, D. and ORBESEN, S. D., *Phys. Lett.* **72B** (1978) 447.

[6] VERGNES, M., ROTBARD, G., KALIFA, J., VERNOTTE, J., BERRIER, G., SELTZ, R., SHARMA, H. L. and HINTZ, N. M., *B.A.P.S.* II, 21, 8 (1976) 976 and to be published.

[7] WAPSTRA, H. and BOS, K., *Atom. Data Nucl. Data Tables* **19** (1977) 215.

[8] MARISCOTTI, M. A. J., SCHARF-GOLDHABER, G. and BUCK, B., *Phys. Rev.* **178** (1969) 1864.

[9] BOURGEOIS, C. *et al.*, Cargèse Conférence 1976 (CERN Report 76-13, p. 456).

[10] VERGNES, M., *Proceedings of the Colloque Franco-Japonais and INS Symposium*, Tokyo-Dogashima (Institute for Nuclear Study, University of Tokyo, 1976), p. 61-75.

[11] IACHELLO, F. and SCHÖLTEN, O., private communication.