INVESTIGATION OF THE ALPHA RADIOACTIVITY OF NATURAL PLATINUM

K. A. PETRZHAK and M. I. YAKUNIN

Radium Institute, Academy of Sciences, U.S.S.R.

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The α radiation of platinum of natural isotopic composition was studied with a grid ionization chamber. More precise values for the α-particle energies and half-life of the isotope Pt^{190} were obtained. A conjecture was made as to the existence of some new α lines in the spectrum.

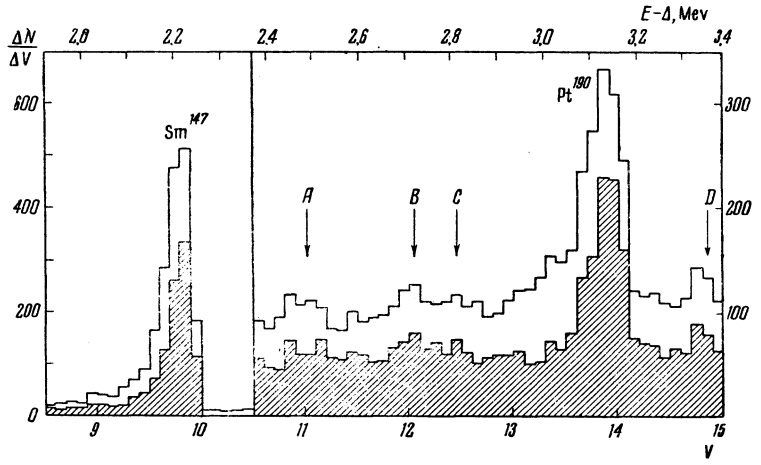
THE α activity of natural platinum was detected for the first time by Porschen and Riezler using photographic plates,[1,2] and was ascribed to the isotope Pt^{190}. Kohman predicted the α activity of this isotope earlier.[3] A half-life T of about 10^{12} years and an α-particle energy E = 3.3 ± 0.2 Mev were found for Pt^{190}. Macfarlane and Kohman,[4] studying platinum enriched in Pt^{190} as well as natural platinum with a large proportional counter, determined the values $T = (6.9 \pm 0.5) \times 10^{11}$ years and E = 3.11 ± 0.03 Mev.

Our investigation of the α activity of platinum was carried out with a cylindrical pulse ionization chamber containing a grid as well as auxiliary equipment, which permitted α particles to be analyzed from the ionization and orientation of their tracks. Taking into account corrections for wall and end effects, the greatest chamber collecting power was $2900 \times 2\pi$ cm^2-sr. The platinum used was a natural isotopic mixture containing up to 0.11% of the usual impurities, 321 ± 5 mg being deposited on the effective surface of the chamber cathode by cathode sputtering. A layer of samarium up to 1 $\mu g/cm^2$ thick covering the platinum, as well as natural uranium, periodically employed, served as reference sources. All the equipment was calibrated and monitored by a generator of pulses of precise height.

When analyzing the α spectra (to be more accurate, the pulse-height distributions), calculated corrections were introduced for the shifting of the peaks. The largest corrections were those associated with energy loss by the α particles in the platinum layer (25—27 kev) and with the effect due to the positive ions (~3 kev for samarium; 4—7 kev for platinum, within the limits of the chosen energy interval; 15 and 22 kev for U^{238} and U^{234} respectively). The remaining corrections, including those associated with electron collection time and the effect of recoil nuclei, were smaller.

The pulse heights were compared with the energies of α particles from the reference sources, taking into account the corrections mentioned above and also the unresolved fine-structure components in the α-particle spectra of the uranium isotopes. The pulse height turned out to be proportional to the energy of the α particles. According to the empirical formula we derived for the α-particle energies ($E = 0.226V + \Delta$, where E is the α-particle energy in Mev, V is the pulse height in relative units, and Δ is the total calculated correction in Mev), the Sm^{147} α particles had an energy of 2.225 Mev, which is close to the recently obtained value of 2.223 + 0.002 Mev,[4] and the main groups of U^{238}, U^{235} and U^{234} α particles had energies of 4.19, 4.39, and 4.77 Mev respectively, that is, close to the known values. This shows the applicability of the given formula to our energy evaluations, and indicates that the ionization is proportional to α-particle energies when α particles with such energies are slowed down in argon containing 5% methane (the gas mixture used in the chamber).

The α spectra obtained by us are presented in the figure. The main peak in the right-hand section, which corresponds to Pt^{190}, yielded an α-particle energy of 3.17 ± 0.02 Mev and a half-life of $(4.7 \pm 1.7) \times 10^{11}$ years. The errors here are somewhat higher than the calculated errors: for the first value because of the indeterminacy of data on the energy of Sm^{147} α particles, and for the second because of the complexity of the spectra obtained. Certain peaks observed in the spectrum could not have resulted from background fluctuations or interference, since the pulses coming from both anode and cathode were analyzed jointly. The possibility is not excluded that certain of these peaks are related to Pt^{190}, but it is impossible to make definite assumptions. We can only note that the α particle groups detected are in no way con-



Pulse-height distribution of α particles emitted from the layer of platinum (321 mg/2900 cm^2) and samarium (~1.8 mg/1900 cm^2) within a solid angle of 2π (outside contour) and 1.1π (crosshatched area). The right-hand section was obtained during 126 hours of observation, the left-hand during 4.6 hours; V is the pulse height.

nected with the well-known energy levels of the Os^{186} nucleus (137 and 764 kev). It is possible to relate group A (corresponding to an energy of ~2.50 Mev) or a part of this group to the probability of detecting α particles from Sm^{146}; the value E = 2.55 ± 0.05 Mev is known[5] from this isotope artificially obtained). Group B (E = 2.75 Mev) and the apparently associated weak group C (E ≈ 2.85 Mev) are observed, but poor statistics and the relatively large background prevent the confirmation of their presence here. We are inclined to assign group B to the isotope Pt^{192}, for which only the lower limit of the half-life, or 10^{14} years, is estimated. We note that Porschen and Riezler,[2] who observed several tracks on photographic plates corresponding to α particles with an energy of ~2.6 Mev, attributed them to Pt^{192}. Macfarlane and Kohman[4] could not detect Pt^{192} α particles, since there was low resolution (width at half maximum of ~0.5 Mev) in the spectrum from the natural platinum. In the present study the resolution in the platinum spectrum was ~80—90 kev. Additional research is necessary to clarify the nature of group D (E ~ 3.40 Mev).

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