THE ^{191,193}Hg AND ^{191,193}Au POSITON DECAYS

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Abstracts.

The positon spectra emitted by ^{191}Hg, ^{193}Hg and their decay products were analyzed with a Gerholm-Lindskog β spectrometer automatically operated. From the analysis of the Fermi-Kuri diagrams, the total decay energies of ^{191,193}Hg and ^{191,193}Au were deduced.

1. Introduction

In the present study, the positon spectra emitted in $^{193+193m}$Hg → ^{193}Au → ^{193}Pt and ^{191}Hg → ^{191}Au → ^{191}Pt decays were measured with a Gerholm-Lindskog β spectrometer. This spectrometer (resolution and transmission ∿ 3%) was operated with a twisted baffle, a scanning magnetic field device [1] and an improved magnetic shielding [2]. In such way, radioactive corrections are avoided as well as spectral distortion due to the stray magnetic field at the photomultiplier. All Hg samples used in these measurements were isotopically separated [3,4].

The Fermi-Kuri plots of the positon spectra were obtained using relativistic Fermi functions corrected for atomic screening Fo Lo* [5]. The different components were interpreted according to the observed half-lives, the experimental Hg, Au and Pt level schemes and intensity balance data.

2. The ^{193}Hg and ^{193}Au positon spectra

The high energy component of this complex spectrum decays with the half-life of $^{193m+193}$Hg ($T_{1/2}$ (^{193}Hg) = 3.8 ± 0.15 h ; $T_{1/2}$ (^{193m}Hg) = 11.8 ± 0.2 h [3]). From the analysis of the transition intensities balance of ^{193}Au, this pure high energy component can be attributed to the decay of ^{193}Hg 3/2$^-$ groundstate towards the $3/2^+_2$ excited level of ^{193}Au. The intensity of this β+ component can be evaluated from its end point energy ($E_{\beta max}$ = 1287 ± 15keV), the relative electron capture plus positon feedings of ^{193}Au levels and the EC/β$^+$ (= 37) theoretical ratio [5]. The intensity obtained in this way corresponds to 7.8 ± 0.7 β$^+$ emitted for 10^4 desintegrations of $^{193m+193}$Hg.

The low energy positon spectrum decays with the ^{193}Au half-life ($T_{1/2}$ = 17.5 h). Two components are brought into evidence by the Fermi-Kuri analysis. On account of the energy difference between their end point energy, they populate the $1/2^-_1$ and $3/2^-_1$ levels in ^{193}Pt. A possible third component could populate the $3/2^-_2$ level. However, due to the energy loss or scattering in the sample and vacuum chamber and the iron hysterisis optical aberrations, this low energy component cannot be satisfactorily resolved.

Finally, the experimental Q values obtained in the present study are slightly higher than Wapstra-Gove predictions (Q(^{193}Hg → ^{193}Au) = 2340 and (Q (^{193}Au → ^{193}Pt) = 1000 keV [6]).

3. The ^{191}Hg and ^{191}Au positon spectra

The Fermi-Kuri plot of this complex spectrum is very similar to the previous one. Indeed a pure high energy component is brought in evidence and follows the ^{191}Hg decay ($T_{1/2}$ = 31 mn). According to intensity balance measurements [7], this high energy component corresponds to the decay of 3/2$^-$ groundstate of ^{191}Hg towards the $3/2^+_2$ excited level of ^{191}Au. The low energy positon spectrum follows the ^{191}Au → ^{191}Pt decay ($T_{1/2}$ = 3,2 h). For similar experimental reasons previously quoted, only two components of this complex low energy spectrum can be resolved. They populate the $3/2^-_1$ groundstate and $1/2^+_1$ (283.9 keV) excited level in ^{191}Pt.

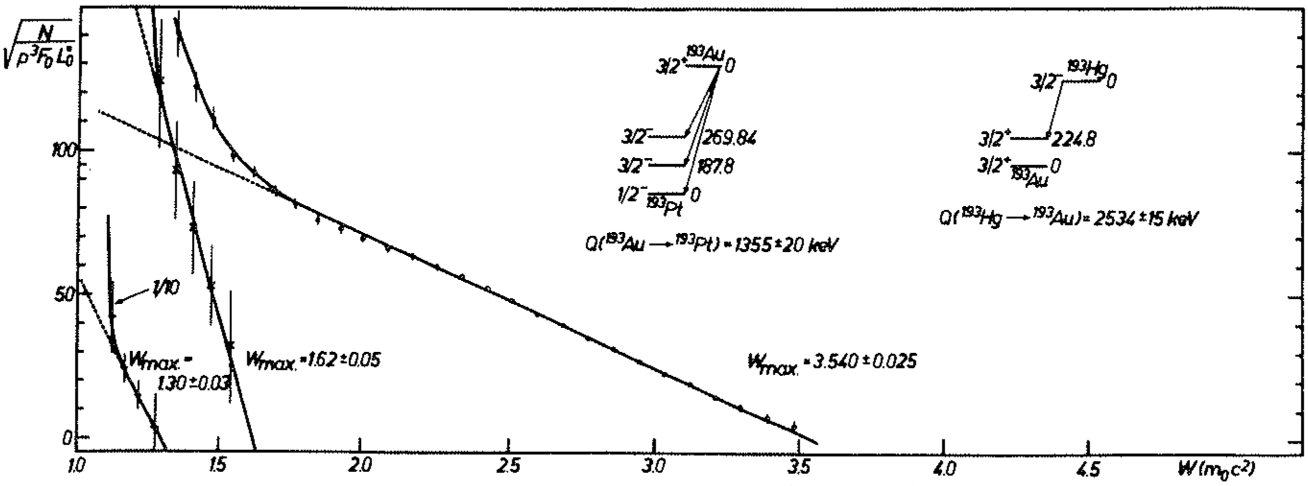

Fig.1 – Positon spectrum emitted by ^{193}Hg and ^{193}Au

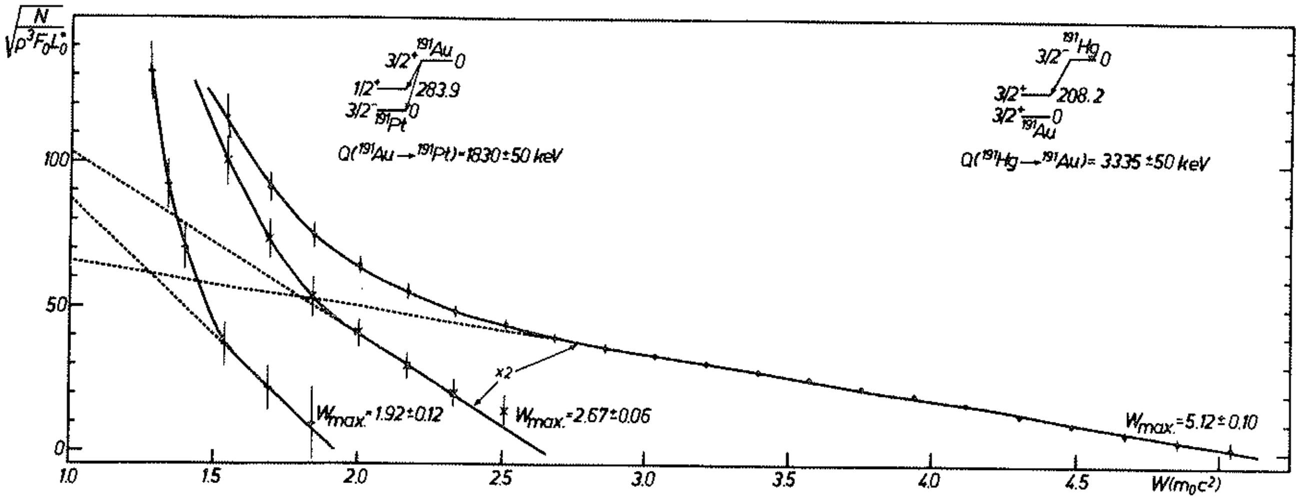

Fig. 2 - Positon spectrum emitted by ^{191}Hg and ^{191}Au

Finally, the experimental Q values measured for ^{191}Hg → ^{191}Au and ^{191}Au → ^{191}Pt decays, agree quite well with the corresponding predictions of Wapstra-Gove ($Q(^{191}Hg \rightarrow {}^{191}Au) = 3300$ keV and $Q(^{191}Au \rightarrow {}^{191}Pt) = 1900$ keV).

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