THE $^{191,193}$Hg AND $^{191,193}$Au POSITRON DECAYS

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Abstracts.

The positron spectra emitted by $^{191}$Hg, $^{193}$Hg and their decay products were analyzed with a Gerholm-Lindskog 8 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 positron spectra emitted in $^{193}$Pt$^{+193m}$Hg $\rightarrow$ $^{193}$Au + $^{193}$Pt and $^{193}$Hg $\rightarrow$ $^{191}$Au + $^{193}$Pt decays were measured with a Gerholm-Lindskog 8 spectrometer. This spectrometer (resolution and transmission $\approx 3\%$) was operated with a twisted baffle, a scanning magnetic field device [1] and an improved magnetic shielding [2]. In such way, radioactive corrections are admitted 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 positron spectra were obtained using relativistic Fermi functions corrected for atomic screening FOLO [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 positron spectra

The high energy component of this complex spectrum decays with the half-life of $^{193}$Hg ($T_{1/2}(^{193}$Hg$) = 3.8 \pm 0.15 h$; $T_{1/2}(^{193}$Hg$) = 11.8 \pm 0.2 h$ [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$^+$ state towards the 3/2$^+$ excited level of $^{193}$Au. The intensity of this $3^+$ component can be evaluated from its end point energy ($E_{\text{max}} = 1287 \pm 15$keV), the relative electron capture plus positron feedings of $^{193}$Au levels and the $BC/\beta^+$ ($= 37$) theoretical ratio [5]. The intensity obtained in this way corresponds to $7.8 \pm 0.7 \beta^+$ emitted for 10$^3$ desintegrations of $^{193}$Hg.

The low energy positron 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$^+$ and 3/2$^+$ levels in $^{193}$Pt. A possible third component could populate the 3/2$^+$ level. However, due to the energy loss or scattering in the sample and vacuum chamber and the iron hysteresis 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-Dove predictions $Q(193$Hg$ \rightarrow 193$Au$) = 2340$ and $Q(193$Au$ \rightarrow 193$Pt$) = 1000$ keV [6].

3. The $^{193}$Hg and $^{191}$Au positron 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$^+$ excited state of $^{191}$Hg towards the 3/2$^+$ excited level of $^{191}$Au. The low energy positron spectrum follows the $^{191}$Au $\rightarrow$ $^{191}$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$^+$ groundstate and 1/2$^+$ (283.9 keV) excited level in $^{191}$Pt.

![Fig.1 - Positron spectrum emitted by $^{193}$Hg and $^{193}$Au](image_url)
Finally, the experimental Q values measured for $^{191}\text{Hg} \rightarrow ^{191}\text{Au}$ and $^{191}\text{Au} \rightarrow ^{191}\text{Pt}$ decays agree quite well with the corresponding predictions of Wapstra-Gove (Q($^{191}\text{Hg} \rightarrow ^{191}\text{Au}$) = 3300 keV and Q($^{191}\text{Au} \rightarrow ^{191}\text{Pt}$) = 1900 keV).

References


7. A. Högland, private communication.