Gamma Rays Intensities of the 9.3h ^{127}Te β^- Decay

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Abstract. The gamma rays of the ^{127}Te β^- decay were studied by means of gamma spectroscopy measurements using high resolution Ge detector, in the region from 150 keV up to 1.0 MeV. Four energies previously attributed to this decay (203.355 keV, 215.645 keV, 360.811 keV and 418.396 keV) were confirmed as well as the intensity of these gamma transitions with a better precision than previously.

Keywords: Te, beta decay, gamma energy, spectroscopy
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INTRODUCTION

During the last years, nuclei rich neutrons, in the mass region ~ 100, have been extensively studied due the transitional behavior associated to them. Experimentally these mesurements are done by means of beta decay and nuclear reactions. However, these investigations result in a large amount of experimental data mainly for even-even nuclei, wihle odd-Z nuclei are less explored. The Iodine isotopes with odd mass belong to this region. Specifically, the absence of experimental data from ^{127}Te decay is mainly due to the fact that 98.8% of its β^- decay populates the ground state of ^{127}I (Z=52). According to the latest compilation performed by Firestone [1] (see Figure1) the level scheme proposed for this beta decay is essentially the study performed by Apt *et al,* in 1970 [2]. An evaluation of the data obtained in this study shows that several transitions of low intensity must be confirmed and others that, although observed in several different nuclear reactions [3] were not placed in level scheme. Furthermore, there is uncertainty in the calculation of the intensity associated with the gamma transitions, which for many transitions comes near to 30%.

In view of these we decided to remeasure this decay using high resolution Ge detector. This paper focuses on accurate measurements of energies and intensities of gamma transitions in ^{127}I, fed through the β^- decay of ^{127}Te.

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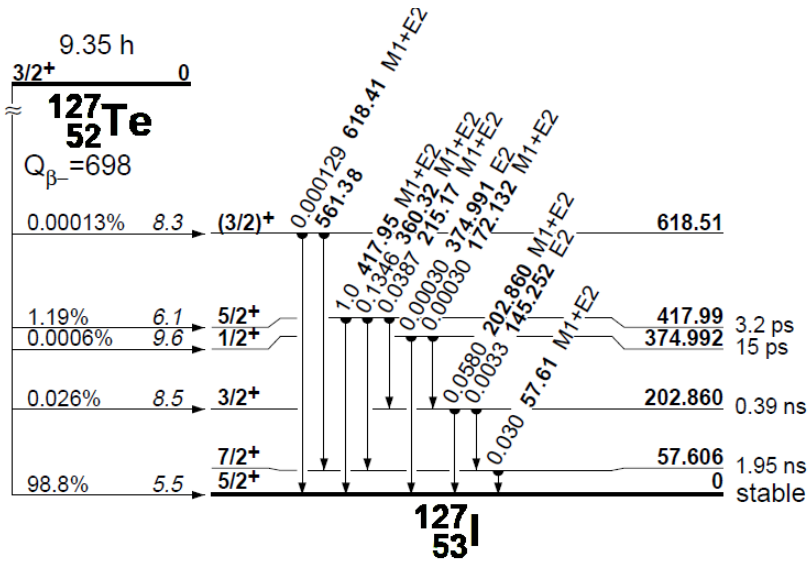

FIGURE 1. Decay scheme of the ^{127}Te [1].

EXPERIMENTAL PROCEDURE

The radioactive sources of ^{127}Te, $T_{1/2}$ = 9.295(5) h [4], were obtained from the ^{126}Te(n,γ)^{127}Te nuclear reaction. Approximately 5 mg of enriched tellurium (98.6%) was irradiated with a thermal neutron flux of ~ 10^{12} n/cm^{2}s, for 5 minutes, in the IEA-R1 Nuclear Reactor at IPEN/CNEN-SP. The gamma ray singles measurements were performed using HPGe spectrometer (198cm^3) with energy resolution of 1.87 keV for the 0.662 MeV transitions of ^{137}Cs and an ORTEC 671 amplifier in pile-up rejection mode, coupled to a MCA ORTEC 919E connected to a PC. The standard sources [5] of ^{133}Ba, ^{137}Cs, ^{60}Co and ^{152}Eu were used for the energy and relative efficiency calibration of the detector. The areas of the gamma rays peaks were evaluated by using the IDF computer code [6].

RESULTS AND DISCUSSION

The direct gamma-ray spectrum from about 150 keV up to 1000 keV was recorded over more than 400 hours of live counting (Figure 2).

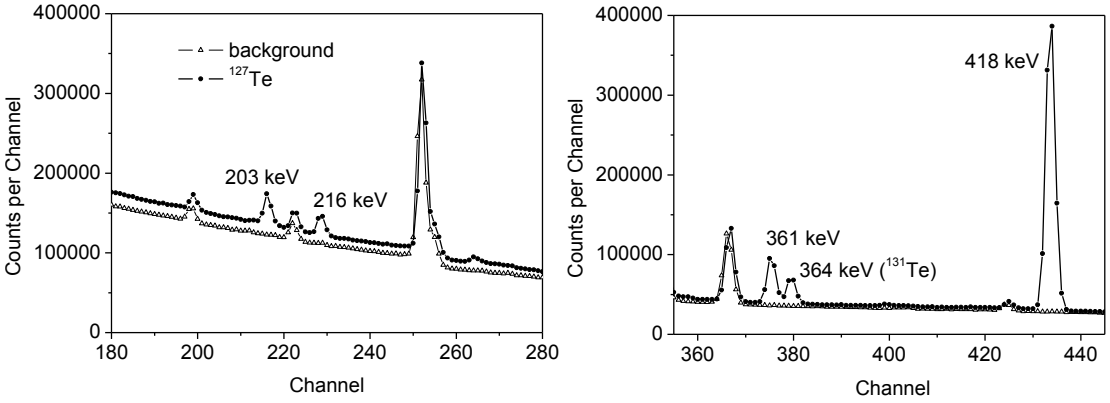

FIGURE 2. Partial gamma ray singles spectrum of the ^{127}Te β^- decay.

The energy and relative intensity of the gamma-rays following the ^{127}Te decay are presented in Table 1. The intensities values obtained are relative to a value of 100% for the gamma intensity of the 418 keV transition.

TABLE 1. Energy (Eγ) and relative intensity (Iγ) of the gamma-rays following the ^{127}Te decay.

This work, 2010 Eγ (keV) Iγ (%)	Apt et al, 1970 Eγ (keV) Iγ (%)
203.355 ± 0.007 6.23 ± 0.15	202.9 ± 0.1 5.86 ± 0.21
215.645 ± 0.008 3.93 ± 0.10	215.1 ± 0.1 3.91 ± 0.17
360.811 ± 0.006 13.30 ± 0.40	360.3 ± 0.1 13.6 ± 0.1
418.396 ± 0.006 100	417.9 ± 0.1 100

In this study the primary reaction (n,γ) using enriched ^{126}Te diminished the activities of the other Te isotopes permitting to confirm the presence of four energies in this decay scheme: 203.355(7) keV, 215.645(8) keV, 360.811(6) keV and 418.396(6) keV. Nowadays, measurements involving singles and coincidence data using a multi-detector system composed of four Compton suppressed HPGe detectors, two of 60% and two of 20% efficiency, are in progress at Laboratório Aberto de Física

Nuclear of the Instituto de Física da Universidade de São Paulo (IFUSP, Brasil). Using this apparatus we intend to confirm others energies involved in this beta decay

CONCLUSION

This study confirms the presence of four energies in the ^{127}Te β^- decay scheme. These data have been determined with a better overall precision than previously. The present results should stimulate future calculations for a precise beta decay scheme.

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REFERENCES

1. R. B. Firestone and V. S. Shirley, *Table of Isotopes*, Vol. I, 8ª ed., Wiley, New York, (1996).
2. K. E. Apt, W. B. Walters and G. E. Gordon, *Nucl. Phys* **A152**, 344-353 (1970).
3. K. Kiato, M. Oshima, *Nuclear Data Sheets* 77, 1- 124, 1996.
4. W. F. Batista, F. A. Genezini, C. B. Zamboni. and G. S. Zahn, *AIP Conf. Proc. Volume* **1139**, 187-188 (2008).
5. IEEA-TECDOC-619, X-Ray and Gamma Ray Standards for Detector Calibration, (1991).
6. P Gouffon. *Manual do programa Idefix,* Instituto de Física da Universidade de São Paulo, Laboratório do Acelerador Linear, 1982.