2009 International Nuclear Atlantic Conference - INAC 2009
Rio de Janeiro,RJ, Brazil, September27 to October 2, 2009
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: **978-85-99141-03-8**

GAMMA TRANSITIONS IN ^{127}Te

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ABSTRACT

This study of the ^{127}Te β^- decay was carried out by means of gamma spectroscopy measurements using high resolution Ge detector, in the region from 150 keV up to 1000 keV, aiming to get a better understanding of the ^{127}Te nuclear structure. Several gamma transitions were confirmed when compared with those published in the last compilation. These data resulting in lower uncertainty.

1. INTRODUCTION

The low-lying levels of odd mass iodine isotopes ($^{127\text{-}133}$I) can be investigated by β and γ decay of the parent tellurium isotopes. These tellurium parent isotopes have shown that properties of low-lying levels vary smoothly through the odd- mass: while the ground state in ^{127}I is $5/2^+$ with the increasing A, the $5/2^+$ level moves up becoming the first excited state in ^{129}I (at 27 keV), in ^{131}I (at 150 keV) and also in ^{133}I (304 keV). According to the last compilation by Firestone [1] several studies have been performed related to decay scheme of $^{129\text{-}133}$Te but, basically, the results of the study performed by Apt *et al*, in 1970 [2] established the features of the βγ decay of ^{127}Te. 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; the remaining (~1%) populating the excited states up to 0.8 MeV. In an attempt to propose a well established β^- decay schema of ^{127}Te motivated us to perform an investigation of excited levels in ^{127}Te. For this purpose, singles measurements were performed using high resolution HPGe spectrometer and enriched ^{126}Te in an attempt to identify these γ-rays of low intensity.

2. EXPERIMENTAL PROCEDURE

The radioactive sources of ^{127}Te ($T_{1/2}$ ~ 9 hs) 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. Singles spectra were carried out using an ORTEC Model GEM-60195 detector (FWHM=1.89 keV at 1320 keV transition of ^{60}Co) and an ORTEC 671 amplifier, in pile up rejection mode, coupled to a MCA ORTEC 919E connected to a PC. The background radiation as well as the escape peaks was reduced by employing the iron shield. The source-detector distance in this experimental apparatus is 12 cm. In this experimental condition several spectra were taken with standards (^{60}Co, ^{109}Cd, ^{133}Ba, ^{137}Cs and ^{152}Eu) [3] for the purpose of the precise energy calibration of γ transitions. The sources of ^{133}Ba and ^{152}Eu [3]

were used for the relative efficiency calibration of the detectors. Areas of the gamma rays peaks were evaluated by using the IDF computer code [4].

3. RESULTS

The direct gamma-ray spectrum from about 150 keV up to 1000 keV was recorded over more than 530 hours of live counting. In order to positively identify the origin of the γ rays, spectra were accumulated through four successive half-lives. The gamma rays identified in this study are shown in figure 1. The half- lives behavior of the each gamma transition observed is in agreement with the established [4].

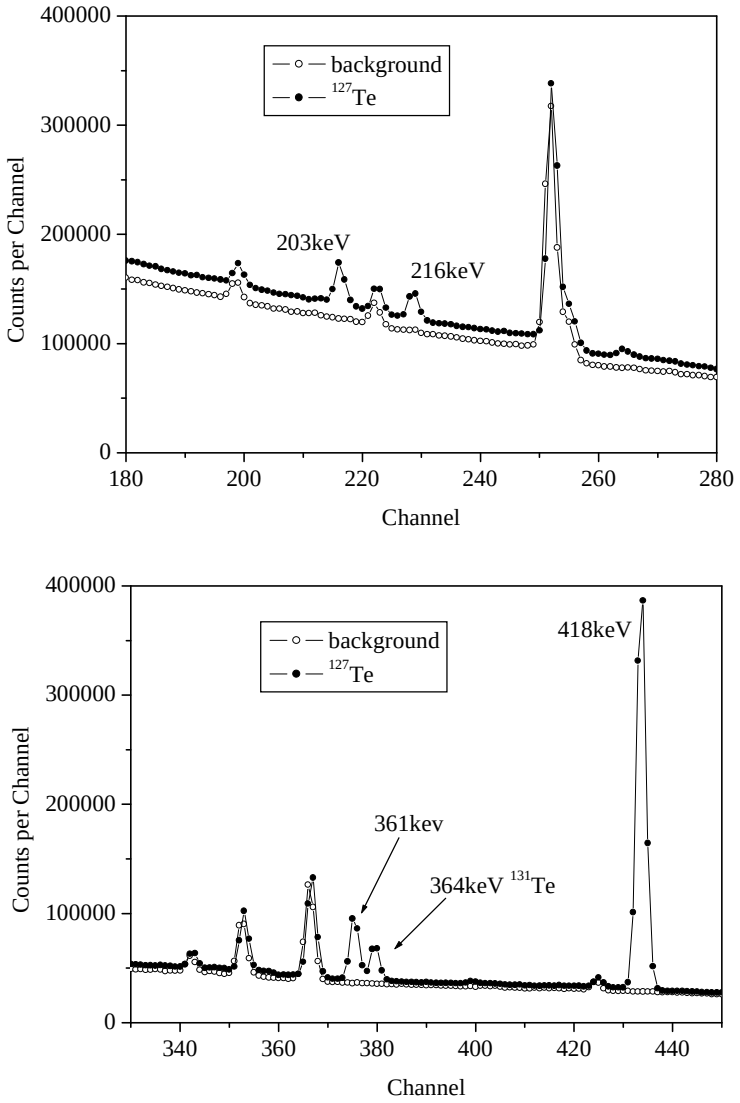

Figure1. Partial gamma ray singles spectrum of ^{127}Te observed with HPGe.

The gamma rays energy are shown in table 1. The background contribution under each gamma transition was determined by a least-squares fit considering the regions adjacent to

both side of the peak [5]. In this table the data from reference 2 are also included for comparison.

Table 1. Gamma ray energy from β^- decay of ^{127}Te.

E_γ (keV) present study	E_γ (keV) Apt *et al* [2]
203.355 ± 0.007	202.9 ± 0.1
215.645 ± 0.008	215.1 ± 0.1
360.811 ± 0.006	360. 3 ± 0.1
418.396 ± 0.006	417.9 ± 0.1

4. DISCUSSION

According to table 1 the energies obtained in the present study are in agreement with data reported earlier [2].

In this study the primary reaction (n, γ) using enriched ^{126}Te diminished the activities of the Te isotopes; in addition the gamma ray spectrum measured with a HPGe (198 cm^3) of high resolution (1.87 keV), comparatively to Ge(Li) detectors used by Apt *et al* [2] (18 cm^3 with FWHM = 2.1 and 26 cm^3 with FWHM = 2.4 keV), resulting is lower uncertainty for these energies.

5. CONCLUSION

In this study gamma rays have been identified in the range of 150 keV up to 1000 keV from β^- decay of ^{127}Te. Ours results confirm the energies previously established.

ACKNOWLEDGMENTS

The authors acknowledge the financial support from FAPESP and SEESP

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