AIP Conference Proceedings

The half-life of 131g,mTe

J. C. Ruivo, C. B. Zamboni, Nilberto Heder Medina, and J. R. B. Oliveira

Citation: AIP Conf. Proc. **1529**, 187 (2013); doi: 10.1063/1.4804114
View online: http://dx.doi.org/10.1063/1.4804114
View Table of Contents: http://proceedings.aip.org/dbt/dbt.jsp?KEY=APCPCS&Volume=1529&Issue=1
Published by the American Institute of Physics.

The Half-Life Of $^{131g,m}Te$

J. C. Ruivo[a], C. B. Zamboni[a], N. H. Medina[b], J.R.B. Oliveira[b]

[a]*Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)*
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP- Brazil
julio.ruivo.costa@usp.br
[b]*Instituto de Física da Universidade de São Paulo, Brazil*
Travessa R da Rua do Matão 187
05508-090 São Paulo, SP
medina@if.usp.br

In this work, the half-lives of ^{131m}Te and ^{131g}Te were measured. Radioactive sources of ^{131}Te were obtained using the $^{130}Te(n,\gamma)^{131}Te$ nuclear reaction. These nuclear parameters have been determined with a better confidence and accuracy than previously available: 18.89 $\pm$ 0.11 min and 33.18 $\pm$ 0.13 h, respectively. These results are quite helpful for new calculations that attempt to describe the low-lying levels in ^{131}I from the decay of $^{131g,m}Te$.

Keywords: **beta decay, half-life, neutron activation, gamma spectrometry, Tellurium.**
PACS: 21.10.-k; 23.40.-s; 27.60.+j

INTRODUCTION

Tellurium isotopes are the focus of studies at LEER/IPEN in partnership with the Pelletron Laboratory, IFUSP, because they are situated in the region of quasi-spherical mass, poorly investigated both in energy range fed via beta decay (50 keV - 3 MeV) and in the region of higher energy (> 3 MeV) via fusion reactions. The most recent studies concerning this nucleus were made involving two different nuclear reactions: (^{3}He,d) and (α,t) [1]. However the most recent research using the (n,γ) nuclear reaction was performed in 1975, using low efficiency Ge(Li) gamma-ray detectors [2] and, basically, the known level scheme of $^{131g,m}Te$ was established on the basis of the results obtained from this experiment. An evaluation of the β-decay half-life obtained from this unique study shows that this nuclear parameter needs a confirmation. In the present work, γ-decay half-lives of ^{131m}Te and ^{131g}Te were measured using a HPGe detector with higher energy resolution and more efficient than previously [2].

EXPERIMENTAL PROCEDURE

Radioactive sources of ^{131}Te were obtained using the $^{130}Te(n,\gamma)^{131}Te$ nuclear reaction. Approximately 5 to 20 mg of natural tellurium was irradiated with a thermal neutron flux of about 3.2 10^{12} n/cm^{2}s, during a few minutes, in the IEA-R1 Nuclear Reactor at IPEN/CNEN-SP. A γ-spectrometer system, composed of an ORTEC HPGe

XXXV Brazilian Workshop on Nuclear Physics
AIP Conf. Proc. 1529, 187-189 (2013); doi: 10.1063/1.4804114

detector (Model GEM-60195, FWHM=1.87 keV for 1.33MeV of ^{60}Co), calibrated for energy through the measurement of standard sources of ^{56}Co, ^{137}Cs and ^{152}Eu [3], coupled to a MCA ORTEC Model 919E and a PC, was used to measure the induced gamma-ray activity. The areas of the gamma rays were evaluated by using the IDF computer code [4].

RESULTS AND DISCUSSION

A total of 8 samples were produced for half-life measurements of ^{131g}Te and 4 for ^{131m}Te. Two gamma rays were selected for measurements involving the short half-life (^{131g}Te):1098 keV and 1500 keV, and 1147 keV from both beta decays (^{131g,m}Te). In **FIGURE 1** is presented the individual fit of each sample (for 1098, 1500 and 1147 keV). In **FIGURE 2** are showed the results from the independent measurements for 1098 and 1500 keV together mean value and standard deviation (solid lines). The results using 1147 keV as well the data from the literature [2] were also included for comparison.

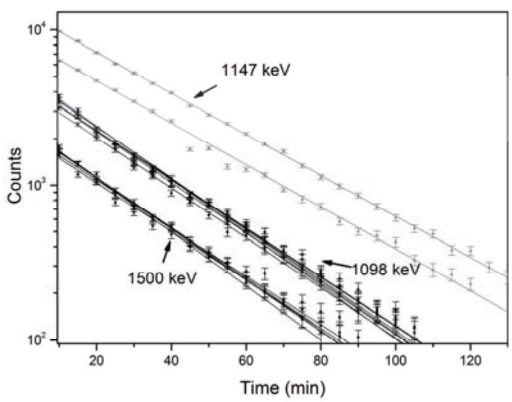

FIGURE 1. The individual fits of the ^{131g}Te

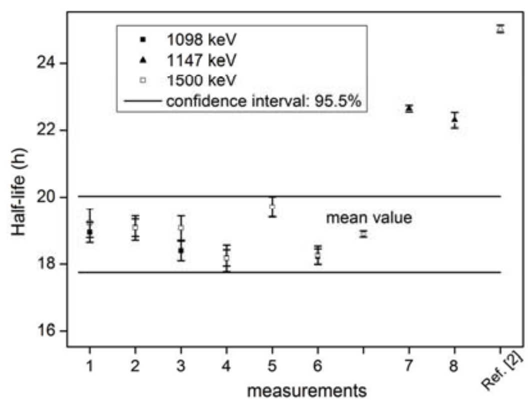

FIGURE 2. The half-life results for ^{131g}Te.

According to **FIGURE 2** there are differences between the data of the present results (for 1147 keV and the mean value from 1098 keV and 1500 keV) and the literature [2]. Considering that the measurements made by Macias *et al* [2] used the 150 keV to 453 keV, energies of both beta decays (^{131g,m}Te), as well as the present measurements using 1147 keV, suggest that the contribution of the long decay life may be interfering.

The 1206 keV from ^{131m}Te was selected for the long half-life measurement and the results are presented in **FIGURE 3** together the mean value, standard deviation (solid line) and the data from literature [5].

A comparison between the present and the references [2,5] are presented in the **TABLE 1**.

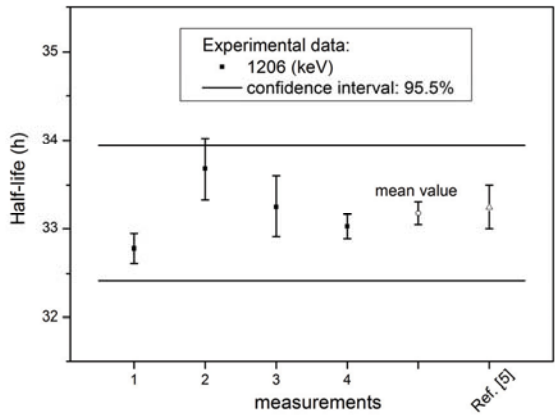

FIGURE 3. The half-life results for ^{131m}Te.

TABLE 1. Present study results in comparison with the references.

	Present Study	[2,5]
Short half-life (min)	18.89 $\pm$ 0.09	25.0 $\pm$ 0.1
Gamma rays (keV)	1098 (^{131g}Te) and 1147 (^{131g,m}Te)	150 and 453 (^{131g,m}Te)
Number of sources	8	1
Long half-life (h)	33.18 $\pm$ 0.13	33.25 $\pm$ 0.25
Gamma ray (keV)	1206 (^{131g}Te)	150 and 453 (^{131g,m}Te)
Number of sources	4	1
Detector	HPGe 198 cm^3	Ge(Li) 15cm^3
Number of channels	4096	300
Resolution (FWHM)	1.89 keV/channel	4.9 keV/channel

CONCLUSION

The viability of using gamma rays (1098 and 1500 keV) involved only in the short half-life (^{131g}Te) eliminates the contribution of ^{131m}Te. The result of this study also confirms the ^{131m}Te half-life and proposes an estimate of half-lives (^{131g,m}Te) with a better confidence and accuracy than previously available. These results are quite helpful for future calculations that attempt to describe with better precision the energy levels in ^{131}I from the decay of $^{131g,\,m}$Te.

ACKNOWLEDGMENTS

The authors acknowledge the financial support from IFUSP and CNPq.

REFERENCES

1. YU. Khazov, I. Mitropolsky, A. Rodionov, Nuclear Data Sheet **107**, 2006, pp. 2782.
2. Macias E.S., Walters W.B., Nucl. Phys**., A161**, 1971, pp. 471.
3. IEEA-TECDOC-619, X-Ray and Gamma Ray Standards for Detector Calibration, 1991.
4. P Gouffon. Manual do programa Idefix, Instituto de Física da Universidade de São Paulo, Laboratório do Acelerador Linear, 1982.
5. V.Jackson, W.B.Walters, R.A.Meyer – Phys.Rev. **C11**, 1975, pp. 1323.