Half Life of ¹²⁷Te

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Abstract. In this work, the half life of the beta-unstable nucleus ¹²⁷Te was studied using neutronirradiated samples of ¹²⁶Te. The gamma activity of each of the irradiated samples was followed for 3-5 consecutive half lives. The results were analysed in two different ways, and the resulting half-life was 9.295(5)h, which is compatible with the tabulated value of 9.35(7)h, with much lower uncertainty.

Keywords: ¹²⁷Te; half life **PACS:** 21.10.Tg; 23.40.-s; 27.60.+j

INTRODUCTION

The half life is a very important parameter on nuclear decays; in particular, the half life of 127 Te is of relevance both to stellar evolution simulations [1] and neutron activation analysis [2]. The presently accepted value [3], is 9.35(7)h, which presents a relative standard deviation of 0.7% and a decrease in this uncertainty would reflect directly in both applications.

EXPERIMENTAL PROCEDURE

In the present experiment, the ¹²⁷Te samples were produced by neutron irradiation of 10 mg-¹²⁶Te-enriched samples for 6 minutes in the pneumatic station of the IEA-R1 nuclear reactor under a thermal neutron flux of approximately $5 \times 10^{12} \text{cm}^{-2} \text{s}^{-1}$. A total of 13 radioactive samples were produced and counted on a 60%-HPGe detector coupled to a 4096-channel MCA; each sample was counted for approximately 40 separate consecutive 1h acquisitions in order to allow for the decay analysis.

CP1139, Nuclear Physics 2008, XXXI Workshop on Nuclear Physics in Brazil, edited by V. Guimarães, J. R. B. Oliveira, K. C. D. Macario, and F. A. Genezini © 2009 American Institute of Physics 978-0-7354-0676-6/09/\$25.00

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DATA ANALYSIS

For the determination of the half-life of ¹²⁷Te, the 417.9keV peak (I_{γ} =100%) was fitted to a gaussian in each spectrum and the peak area (C) was fitted, using a covariant Gauss-Marquardt routine implemented in MatLab environment, to a simple exponential decay (Eq.1) by two different approaches:

- In the first, C(t) was determined individually for each sample and then the weighted average of the values obtained for all samples was calculated (Fig. 1a);
- In the second, data from all samples were gathered in a single fit together with a "normalization" parameter for each, so that a single value for the half-life is fitted (Fig. 1b).



RESULTS

The weighted average of the 13 individual fits resulted in a half-life of 9.294(5)h, while the result of the complete 431h fit was 9.295(5)h; both values are almost identical, and both agree with the value found in reference [3] (9.35(7)h), with enhancement of more than 1 order of magnitude in the uncertainty.

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