Half Life of ^{127}Te

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Abstract. In this work, the half life of the beta-unstable nucleus ^{127}Te was studied using neutron-irradiated samples of ^{126}Te. 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: ^{127}Te; half life
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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 ^{127}Te samples were produced by neutron irradiation of 10mg-^{126}Te-enriched samples for 6 minutes in the pneumatic station of the IEA-R1 nuclear reactor under a thermal neutron flux of approximately $5x10^{12}cm^{-2}s^{-1}$. 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.

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DATA ANALYSIS

For the determination of the half-life of ^{127}Te, 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).

$$C(t) = A \cdot e^{-t \cdot \ln 2 / T_{1/2}} \tag{1}$$

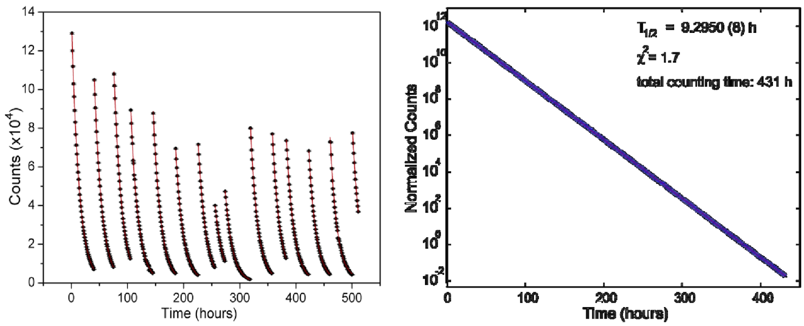

FIGURE 1. Left (1a): Individual fits of the 13 samples;
Right (1b): All 431h of data acquisition fitted in a single session;

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.

REFERENCES

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