Medical Applications of Nuclear Physics

Kristian Vorland Liodden & Oskar Ekeid Idland
University of Oslo
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INTRODUCTION

I. THEORY

II. EXPERIMENTAL SETUP

III. ANALYSIS

A. Finding Activity from Fitted Peaks

The activity from nuclear decay follows an exponential form as follows:

$$A(t) = A_0 e^{-\lambda t} \tag{1}$$

with A_0 being the initial activity and λ the decay constant. The decay constant for each isotope is already known to be $\lambda_{108} = 2.382$ minutes and $\lambda_{110} = 24.56$ seconds for ^{108}Ag and ^{110}Ag respectively. The total number of decays from a delayed time t_d after end of irradiation, with a counting time of t_c is given by:

$$N_D = \int_{t_d}^{t_d+t_c} A(t)\ \mathrm{d}t. \tag{2}$$

Solving eq. (2) gives:

$$N_D = \frac{A_0}{\lambda} e^{-\lambda t_d} \left(1 - e^{-\lambda t_c}\right) \tag{3}$$

combined with eq. (1) gives:

$$N_D = \frac{A(t_d)}{\lambda} \left(1 - e^{\lambda t_c}\right). \tag{4}$$

We are not able to count every decay, as the detector has a finite efficiency ϵ, and different photon energies have different intensities I_γ. The number of counts N_C is then given by:

$$N_C = \epsilon I_\gamma N_D \tag{5}$$

Combining eq. (5) and eq. (4) we can express the activity at a delayed time t_d as:

$$A(t_d) = \frac{N_C \lambda}{\epsilon I_\gamma \left(1 - e^{-\lambda t_c}\right)}. \tag{6}$$

With multiple successive measurements of the number of counts N_C at different delayed times t_d, we are able to fit the data to the exponential form and find the initial activity A_0 at the end of irradiation.

IV. RESULTS

V. DISCUSSION

VI. CONCLUSION

VII. APPENDIX

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REFERENCES