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The correlations between the emission probabilities of the more intense gamma rays in ^{152}Gd and ^{152}Sm following ^{152}Eu decay.

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Introduction

In a previous work [1], we presented the steps needed to find out the correlations between gamma-ray emission probabilities. Here, we show the results obtained by the application of the method to the intense gamma-rays of the decay of ^{152}Eu.

We started calibrating both the total and the total energy absorption detector efficiencies. Then we proceeded to determine the decay parameters: branching-ratios and beta feeding fractions, with their full variance matrix, by fitting the observed peak areas with appropriate formulas deduced from the decay scheme, taking into account the secondary detection effects, particularly summing. Finally, from these data and the decay scheme, we calculated the emission probabilities along with the variance matrix.

Modeling the ^{152}Eu decay

The ^{152}Eu decays both via β^- and β^+decay, which are followed respectively by 44 and 91 gamma-ray transitions. In this first experiment with ^{152}Eu, only the intense gamma-ray transitions from the decay were taken into account. For these transitions, the corresponding gamma peak areas were observed, and the decay parameters - branching-ratios and feeding fractions - were fitted. Therefore some transitions had not their areas taken into account in the fit, but their intensities were used as fixed values for assuring the consistency of the ^{152}Eu decay scheme, and some constraints (the total feeding, and the sums of the branching-ratios) were used to eliminate the parameters.

The model corresponding to the scheme of the ^{152}Eu was divided in two parts, due to the β^- and the β^+ decay. For each decay mode, the peak-areas were fitted to the experimental data points by the Least Square Method. The variance matrix has three components due to the uncertainties in the peak areas, peak efficiency and the total-to-peak detection ratio.

The detection system and the efficiency calibration

The detection system consists in a 160 cm^3 HPGe detector, with the source placed 20 cm away the detector capsule. Calibrated sources of ^{88}Y, ^{60}Co, ^{54}Mn with activities between 2 and 4 kBq calibrated in a 4π-$\beta\gamma$ detector were used, along with sources of ^{137}Cs, ^{152}Eu and ^{133}Ba with 30 kBq. The intention is to replace the low energy data of Eu and Ba with data coming from sources with simple decay scheme: ^{57}Co, ^{51}Cr, etc., but we did not succeed in getting the material for preparing the corresponding calibrated sources yet.

The total efficiency was determined from the total-to-peak ratio, measured with uncalibrated monochromatic sources, and the efficiency for the full energy peak.

Measurements and some results

The disintegration data was obtained from a 10 kBq ^{152}Eu source, with the detector heavily shielded in a measurement of 165 h. The fit along the lines described above was performed separately for the gamma rays following the β^- and the β^+ decays. For the β^- decay part a chi-square value equal to 2.23 with one degree of freedom was obtained and for the β^+ decay we obtained a chi-square value equal to 0.53 with one degree of freedom.

Although the overall precision is not good and also we do not have a reliable efficiency calibration, the results obtained are compatible with published data.

With the decay scheme parameters of ^{152}Eu, all the gamma-ray transition probabilities can be determined, and their variance matrix can be deduced by using a propagation formula. All the correlations obtained are moderately important, which follows from properties of the decay scheme, reflected in the set of equations.

Conclusion

We determined the correlation matrix of the gamma-ray emission probabilities of the strong gamma-rays following the decay of ^{152}Eu which forms a very correlated data set. However, this is not the simplest data set to be used when performing a precise efficiency calibration, when summing effects corrections are inevitable. Sum depends on the level feeding fractions from the parent nucleus and the branching ratios, which in turn form the easiest data set to determine when looking for the gamma-ray emission probabilities. We conclude, therefore, that it would be useful to publish the beta feeding fractions and the branching-ratios, with the respective variance matrix.

Reference

[1] Summary Report of the first research co-ordination meeting on Update of X- and g-ray decay data standards for detector calibration and other applications, INDC(NDS)-403 (1999) 73.

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SISTEMA DE MEDIDA NÃO INVASIVA DA TENSÃO EM TUBOS DE RAIOS-X ODONTOLÓGICOS UTILIZANDO O MÉTODO DOS FILTROS

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O controle de exposições em radiologia odontológica apresenta dois desafios: o primeiro é o desenvolvimento de um sistema de medida simples, barato e confiável, e o segundo é a sua aplicação com relação ao controle da radiação. em um país grande como o Brasil. O sistema de medida proposto neste trabalho faz parte de um Kit contendo filmes de radiografia odontológica, dosímetros termoluminescentes (TLDs) e filtros, visando medir o tamanho de campo, a dose de entrada na pele para uma técnica radiográfica de um dente molar, a camada semi redutora (HVL) e a tensão pico (kVp). O método para a determinação da tensão aplicada aos tubos de raios X utilizado é não invasivo e se baseia no valor da razão entre as exposições medidas TLD após o feixe de raios X atravessar dois filtros de cobre e/ou alumínio com espessuras diferentes. Este é o princípio de operação de diversos modelos de medidas eletrônicas de tensão. Assim, com a irradiação dos "KITs" em um aparelho de raios X com tensão variável foram feitas medidas simultaneamente atrás de ambos os filtros, estabelecida a razão entre elas e, a seguir, uma função da tensão do tubo e a razão. De acordo com os resultados preliminares, o método se apresenta adequado para a medida da tensão aplicada aos tubos de raios X no intervalo de variação de 50 a 80 kV.

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Estudo e Montagem de Sistema de Medida de Radiação Beta

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No projeto e montagem de um sistema de detecção de radiação beta a espessura do detector - plástico cintilador - é determinada pelo alcance da partícula carregada de maior energia a ser observada. Para baixas energias, espessuras de 1/4 de mm podem apresentar aproximadamente 100% eficiência por partículas carregadas que atingem o detector e quase nenhuma resposta de radiação gama. Os detectores cintiladores podem ser contruidos com maior espessura se houver interesse na detecção da radiação gama ou se ela não constituir um problema para as medidas que estão sendo realizadas. No estudo realizado, foi montado um sistema de medidas usando um plástico cintilador de 3mm de espessura. Essa dimensão do detector fornece uma boa eficiência de detecção para radiação beta e praticamente nenhuma interferência da radiação de fundo do laboratório. Foram obtidas eficiências de aproximadamente 43%