

Determination of X- and gamma-ray emission intensities in the decay of ¹²³I and ¹⁷⁷Lu



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Introduction

lodine-123 and lutetium-177 are both radionuclides developed for radiopharmaceutical use. Their **short half-lives** make them convenient for diagnosis and they are also used for therapy.

To contribute to a better characterisation of these radionuclides,. two experiments were conducted to determine the photon emission intensities of both radionuclides by gamma- and X-ray spectrometry.

Radionuclides decay scheme

¹²³I – Electron capture – Half-life=13.2234(37) h



Full decay scheme



Simplified decay scheme

¹⁷⁷Lu – β^- – Half-life=6.647(4) d



Full decay scheme

Gamma- and X-ray spectrometry

Eight point sources for each radionuclide (homogeneity checking) Gamma-and X-ray spectrometry using 4 HPGe detectors

For ¹²³I: two measurement distances:

- 10 cm: efficiency calibration with lowest relative uncertainty (about 0.5%)
 - 2 cm + cadmium screen to reduce intense
- low-energy photons and quantify lower emission intensities



Source at 10 cm



Source at 2 cm with Cd





For ¹⁷⁷Lu: activity per unit mass of the solution used to prepare the point sources calibrated by $4\pi \beta - \gamma$ coincidences (liquid scintillation detector in the β channel)



Gamma-ray emission intensities quantified with two large HPGe detectors.

X-ray emission intensities measured with two small HPGe detectors

Peaks fitted with Lorentzian shapes using COLEGRAM

Natural width of X-rays imposed



Hf K X-rays in the decay of ¹⁷⁷Lu



Example of processing of Hf L X-rays in the decay of ¹⁷⁷Lu

Photon emission intensities

Relative values for ¹²³I: 4 major lines and 24 minor ones



Comparison of present results with previously published data (relative to main line (159 keV))

Absolute emission intensities (%) for 6 lines of ¹⁷⁷Lu:

€ 12.2 _ 208 HeV ≥ 12.0 - 5 § 11.8 -	Energy (keV)	DDEP (2002)	This study
u 1114 112 112 112 112 112 112 112	71.64	0.164(5)	0.1714(23)
	112.95	6.23(4)	6.235(46)
	136.72	0.0465(4)	0.0472(8)
	208.37	10.41(4)	10.48(7)
Absolute emission intensity of the 208 keV	249.67	0.1997(13)	0.2015(15)
	321.32	0.2186(32)	0.2067(39)



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