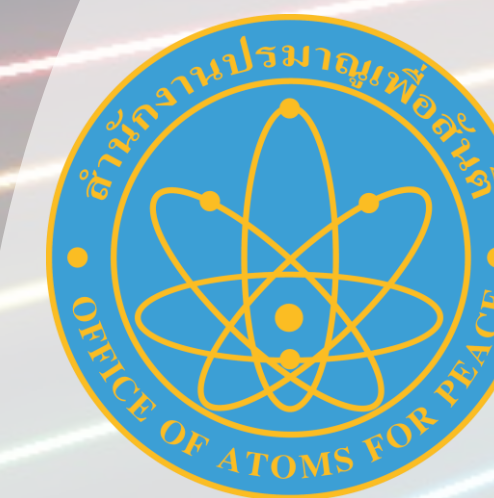


The absolute measurement of ^{131}I radioactivity for γ -ray nuclide standardization

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INTRODUCTION

Accurate radionuclide measurements are vital for nuclear medicine and radiation safety in Thailand. The National Standard Radioactivity Laboratory (NSRL) of the Office of Atoms for Peace (OAP), recalibrated its 4π ionization chamber for ^{131}I , a key medical isotope, to improve standardization. This recalibration was undertaken in preparation for a 2025 Interlaboratory Proficiency Testing (IPT) program involving 23 laboratories across Thailand [fig. 2]. To improve activity measurement accuracy and comparability in the 2025 IPT, the OAP established a new ^{131}I calibration factor. This poster outlines the process and discusses factors influencing 4π ionization chamber accuracy, reflecting a significant change from the previous value.



Figure 1 Traceability chain for radioactivity measurements using radionuclide calibrators

OBJECTIVES

1. Recalibrate 4π ionization chamber of NSRL for ^{131}I activity measurements to improve accuracy and consistency.
2. Establish a reliable reference standard for the 2025 Interlaboratory Proficiency Testing (IPT) program, enabling participating laboratories to evaluate their measurement capabilities.

The $4\pi\beta(\text{PPC})$ - γ coincidence system

The $4\pi\beta(\text{PPC})$ - γ coincidence system of OAP has dual photomultipliers, NaI(Tl) and proportional counters for gamma/beta detection. Signals are acquired by analog and NI digitizers. This system is crucial for accurate medical isotope calibration and measurement.

SOURCE PREPARATION

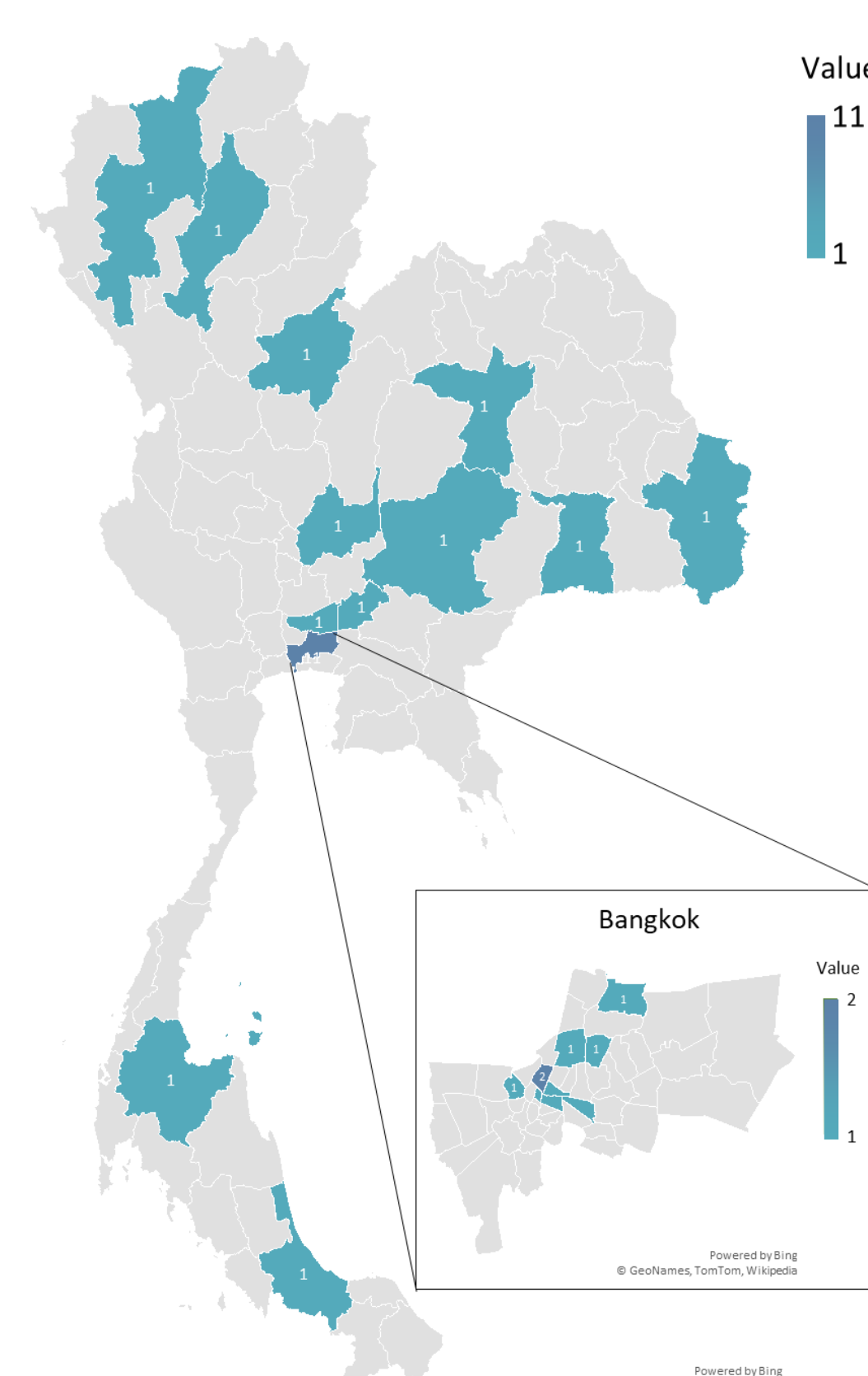


Figure 2 Participants' distribution in 2023

A mother solution was prepared from delivered ^{131}I . Point sources were created using aluminum plates with a central aperture, coated with a Collodion/isopentyl acetate film and gold for uniform deposition. They were then precisely loaded with 9.49 mg of ^{131}I solution, fixed with LUDOX, and encapsulated with a top aluminum film. Gold coating minimized electrostatic charge, and LUDOX prevented leaching. All preparations, including OAP-type ampoules (5 cc, clear borosilicate glass) weighing from 1 to 4.5 g and a 1000 cc Marinelli beaker for impurity measurements, were performed in a controlled environment to ensure accuracy and minimize contamination.

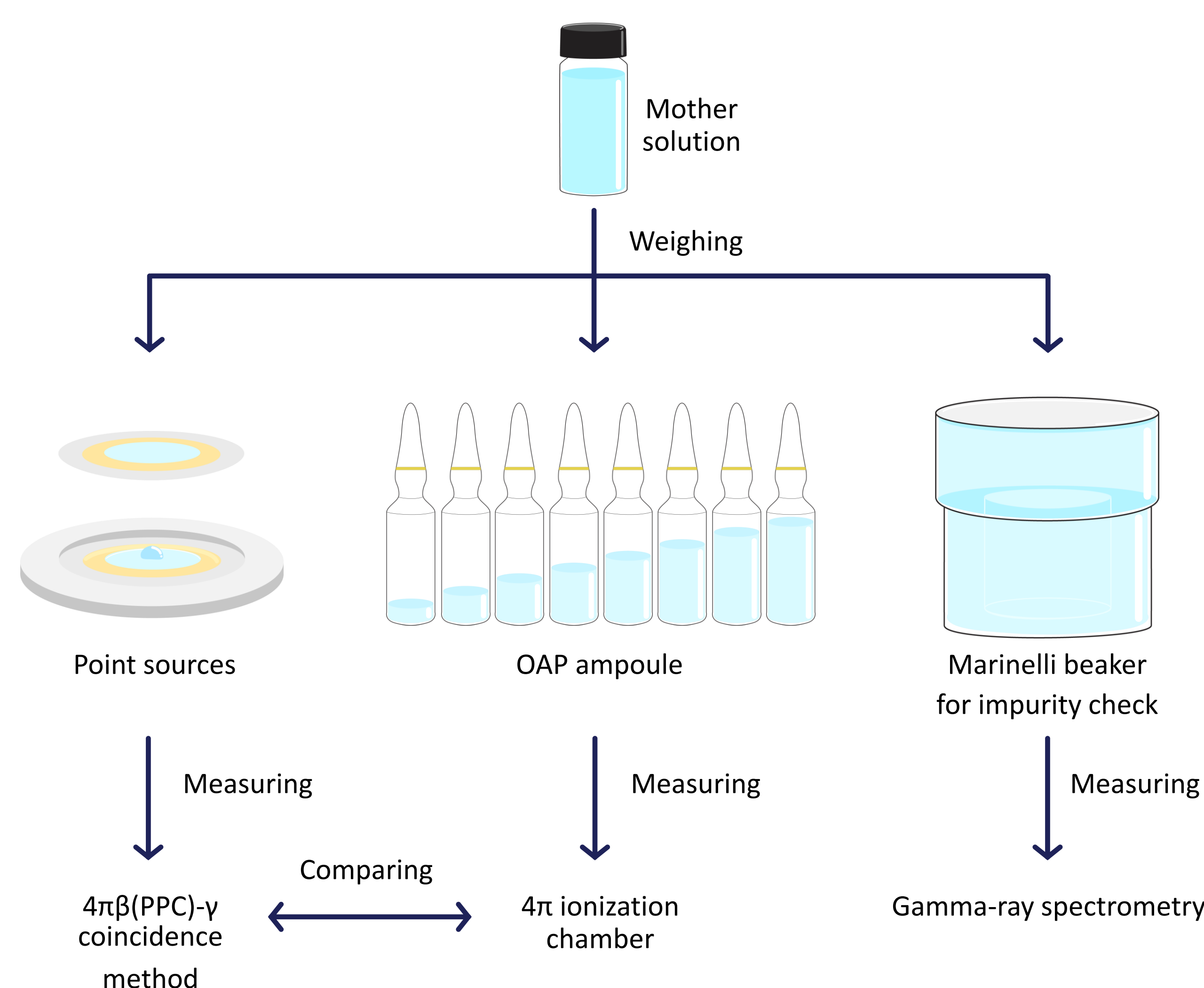


Figure 3 Source preparation scheme

RESULTS AND DISCUSSION

Table 1 Uncertainty budget of the ^{131}I calibration of the OAP ionization chamber.

Contributions due to	Standard uncertainty (%) (k=1)	
	A	B
Weighing	-	2×10^{-4}
Stability of IC system	0.25	-
IC current measurement	0.05	-
Repeatability of ^{131}I measurement	0.25	-
Decay correction of ^{131}I	-	0.5
Radioactivity of ^{131}I source from standardization	-	1.5
Impurities	-	0.1
Background instability	-	0.1
Calculated response	-	1.1
Half-life	-	0.24
Ampoule thickness	-	0.10
Quadratic sum	0.36	1.95
Relative combined standard uncertainty, u_c	1.52	

Table 2 Ionization chamber calibration factors.

Methods	Calibration factor (pA MBq ⁻¹)	Standard uncertainty (%) (k=2)	E_n ratio
Pressurized IC*	5.72	2.6	0.28
$4\pi\beta$ - γ coincidence	6.85	3.1	

* Using the IC response curve traceable to the NIST and the NMJ since 2004

CONCLUSIONS

The OAP calibrated its ^{131}I reference chamber, yielding a nuclide efficiency of 6.85 (21) pA MBq⁻¹ and absolute activity of 902.84 (61) kBq g⁻¹. An E_n ratio of 0.28 confirms readiness for the 2025 IPT.

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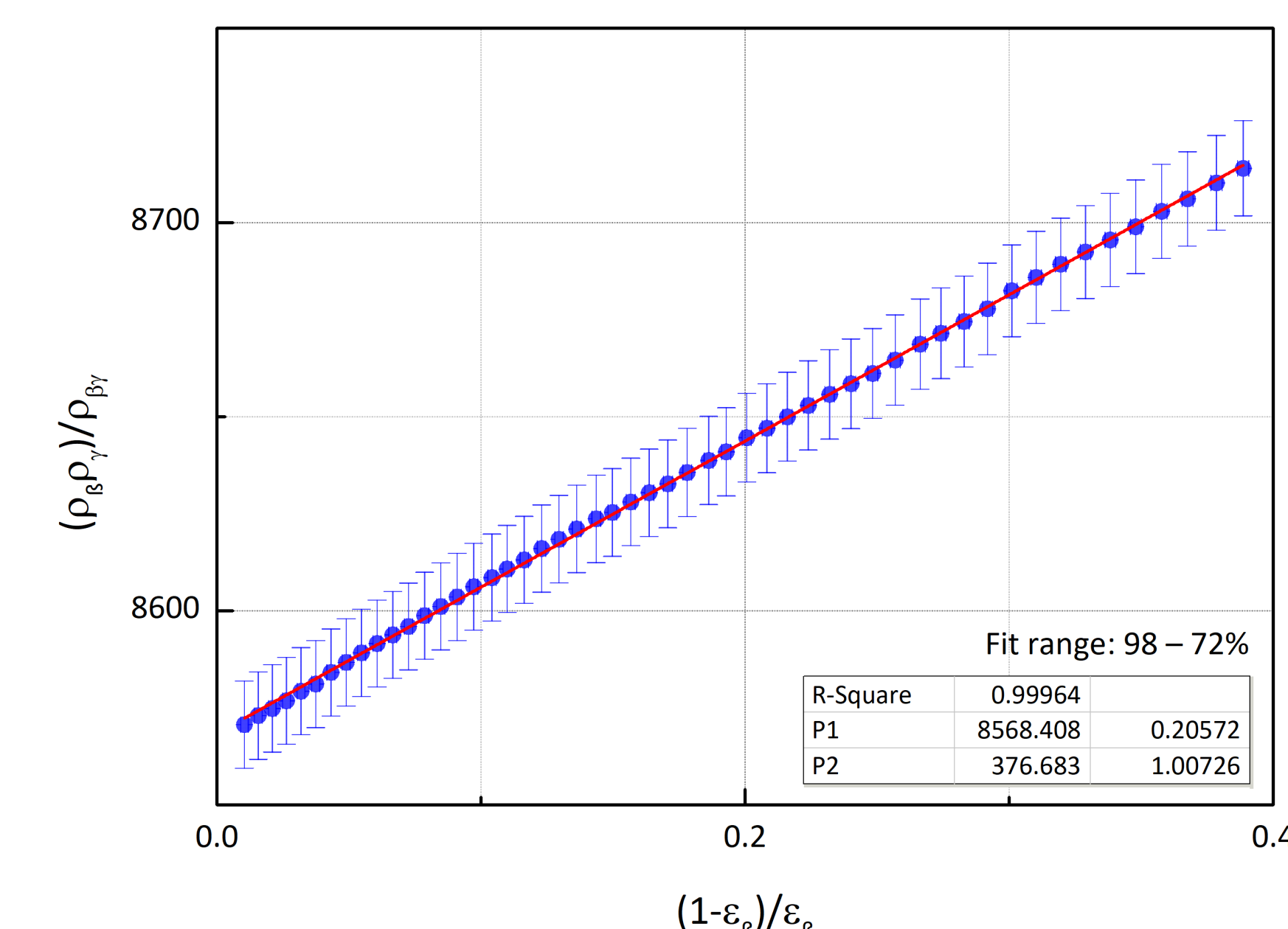


Figure 4 Efficiency extrapolation curve of ^{131}I

An extrapolation technique for various β efficiency was used to determine the activity:

$$A = \frac{\rho_\beta \rho_\gamma}{\rho_\beta \rho_\gamma}$$

A: Activity
 ρ_β : Counting rate from β detector
 ρ_γ : Counting rate from γ detector
 $\rho_\beta \rho_\gamma$: Coincidence counting rate

The OAP ampoule source measurement in the ionization chamber was started at the 2004; its result was corrected for long-term instability as measured by a $^{166\text{m}}\text{Ho}$ reference source:

$$A = \frac{I}{\epsilon_N I_r(t_0)}$$

A: Activity
I: Measured current of ^{131}I
 ϵ_N : Nuclide efficiency of ^{131}I
 I_r : Arbitrary constant to normalize the $^{166\text{m}}\text{Ho}$ reference source
 $I_r(t_0)$: Current measured and corrected to a fixed reference date (t_0) with $^{166\text{m}}\text{Ho}$ reference source.