Validation of the code TDCRPy against the code Fe-55fom

Romain Coulon

Bureau International des Poids et Mesures, Pavillon de Breteuil, F-92312 Sèvres Cedex, France.

1. Introduction

The code Fe-55fom was developed in Fortran by Philippe Cassette at the LNE-LNHB to calculate the efficiency of a TDCR system when standard solutions of ^{55}Fe are measured. It implement a K,L,M shells recombination model. It was used by the LNE-LNHB, the ENEA, the KRISS, the NIM, the POLATOM, the SMU and the BIPM during the comparison CCRI(II)-K2.Fe-55.2019. The BIPM developed the python code TDCRPy to estimating detection efficiency of TDCR measurement. The aim of this study is to test the BIPM code against the Fe-55fom code.

2. Measurement data and results

2.1. symmetric assumption

Table 1: Measurement data and results - $kB = 0.008$ cm $\cdot$ MeV^{-1}

Source	R_{AB} /s	R_{BC} /s	R_{AC} /s	R_D /s	R_T /s	ϵ_D **Fe-55fom**	ϵ_D **TDCRPy**	error
1	800	800	800	1000	700	83.72 %	84.20 %	+0.48 %
2	733	733	733	1000	600	79.73 %	79.99 %	+0.26 %
3	666	666	666	1000	500	73.59 %	73.23 %	-0.36 %
4	600	600	600	1000	400	64.50 %	63.95 %	-0.55 %
5	533	533	533	1000	300	51.56 %	51.02 %	-0.54 %
6	467	467	467	1000	200	34.13 %	34.10 %	-0.03 %
7	400	400	400	1000	100	13.51 %	13.71 %	+0.20 %

Table 2: Measurement data and results - $kB = 0.01$ cm · MeV^{-1}

Source	R_{AB} /s	R_{BC} /s	R_{AC} /s	R_D /s	R_T /s	ϵ_D **Fe-55fom**	ϵ_D **TDCRPy**	error
1	800	800	800	1000	700	83.67 %	84.32 %	+1.00 %
2	733	733	733	1000	600	79.69 %	79.89 %	+0.20 %
3	666	666	666	1000	500	73.54 %	73.47 %	-0.07 %
4	600	600	600	1000	400	64.45 %	64.01 %	-0.44 %
5	533	533	533	1000	300	51.51 %	51.07 %	-0.44 %
6	467	467	467	1000	200	34.09 %	33.87 %	-0.22 %
7	400	400	400	1000	100	13.49 %	13.81 %	+0.32 %

Table 3: Measurement data and results - $kB = 0.012$ cm · MeV^{-1}

Source	R_{AB} /s	R_{BC} /s	R_{AC} /s	R_D /s	R_T /s	ϵ_D **Fe-55fom**	ϵ_D **TDCRPy**	error
1	800	800	800	1000	700	83.64 %	84.30%	+0.66 %
2	733	733	733	1000	600	79.65 %	79.96 %	+0.31 %
3	666	666	666	1000	500	73.50 %	73.28 %	-0.22 %
4	600	600	600	1000	400	64.41 %	64.10 %	-0.31 %
5	533	533	533	1000	300	51.47 %	51.19 %	-0.28 %
6	467	467	467	1000	200	34.05 %	33.99 %	-0.06 %
7	400	400	400	1000	100	13.47 %	13.74 %	+0.27 %

The comparison CCRI(II)-K2.Fe-55.2019 shows that results from laboratories are spread by ± 1% around the KCRV and that laboratories report relative standard uncertainties dominated by their efficiency model of values: $\{0.62, 0.70, 0.81, 0.92, 0.41, 0.59, 0.45, 0.63, 0.39, 0.50, 0.46, 1.57\}\%$. These fluctuations are in agreement with the deviations observed between TDCRPy and Fe-55fom estimations that are comprises between -0.03% to -0.55% in the efficiency range $[30 - 60]\%$ that can be encountered in TDCR systems.