Water Samples Analysis

April 2020

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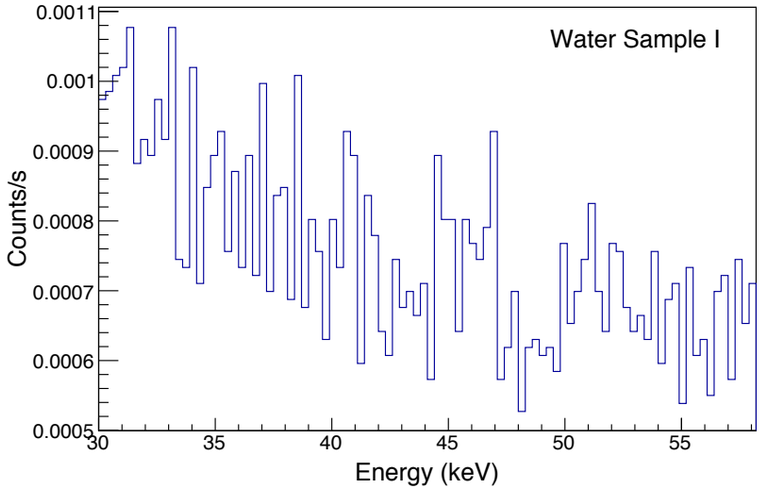
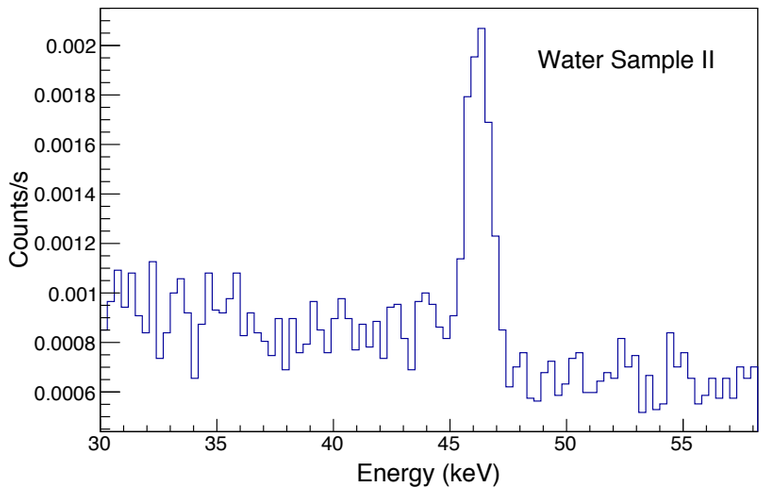
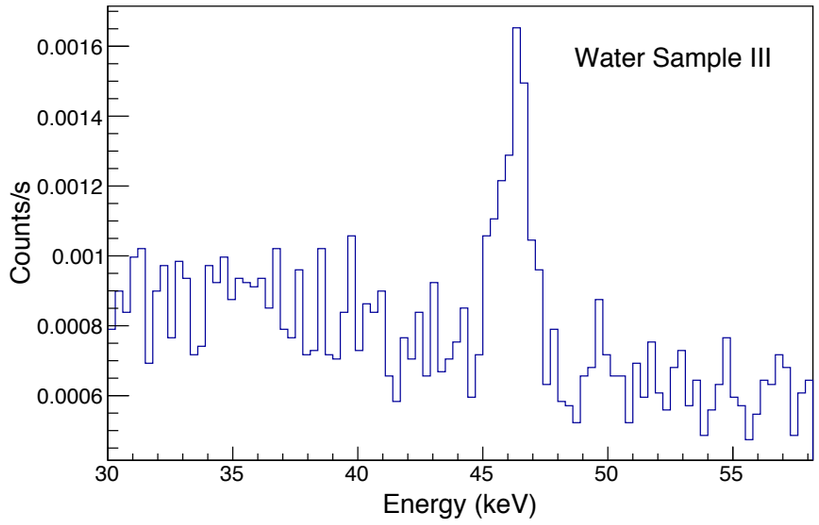
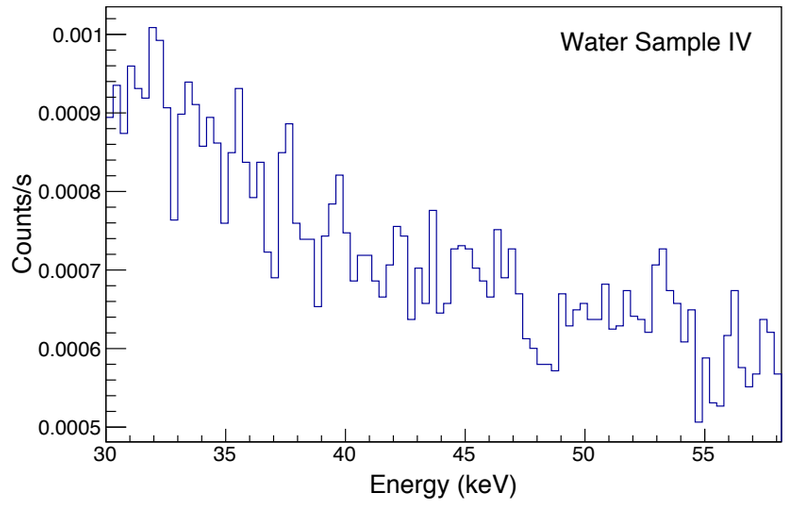
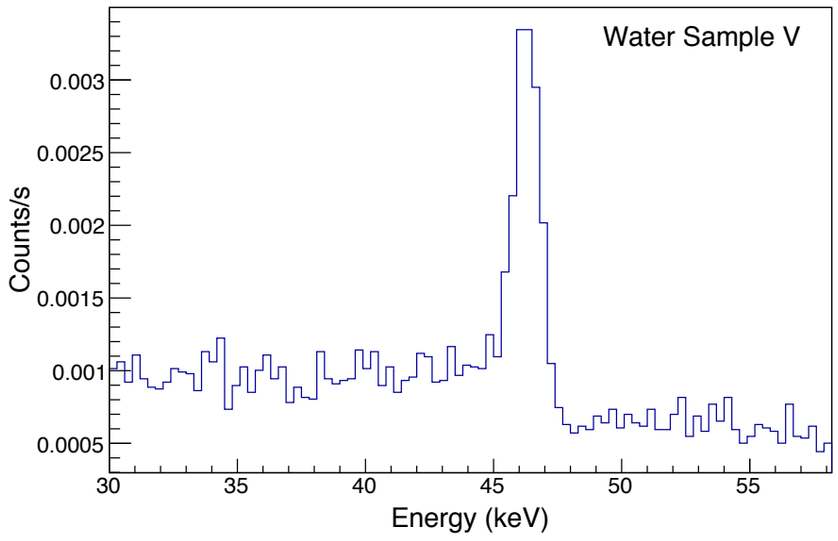
Water samples measured spectra with IF Canberra detector

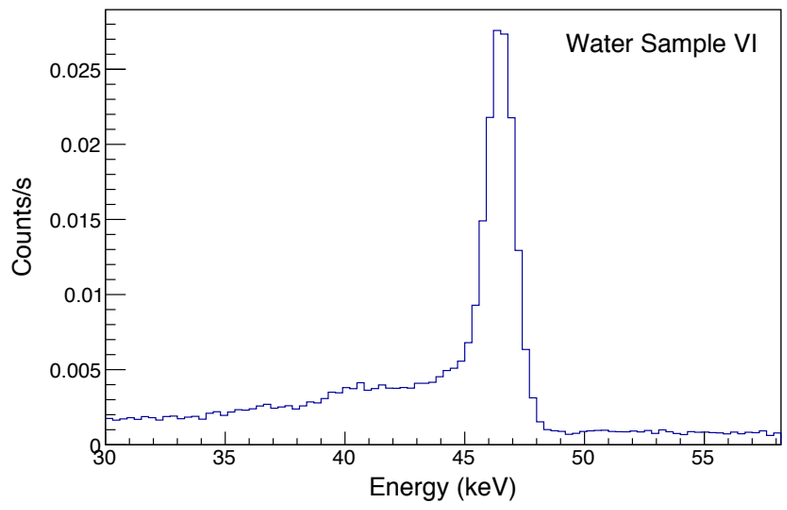










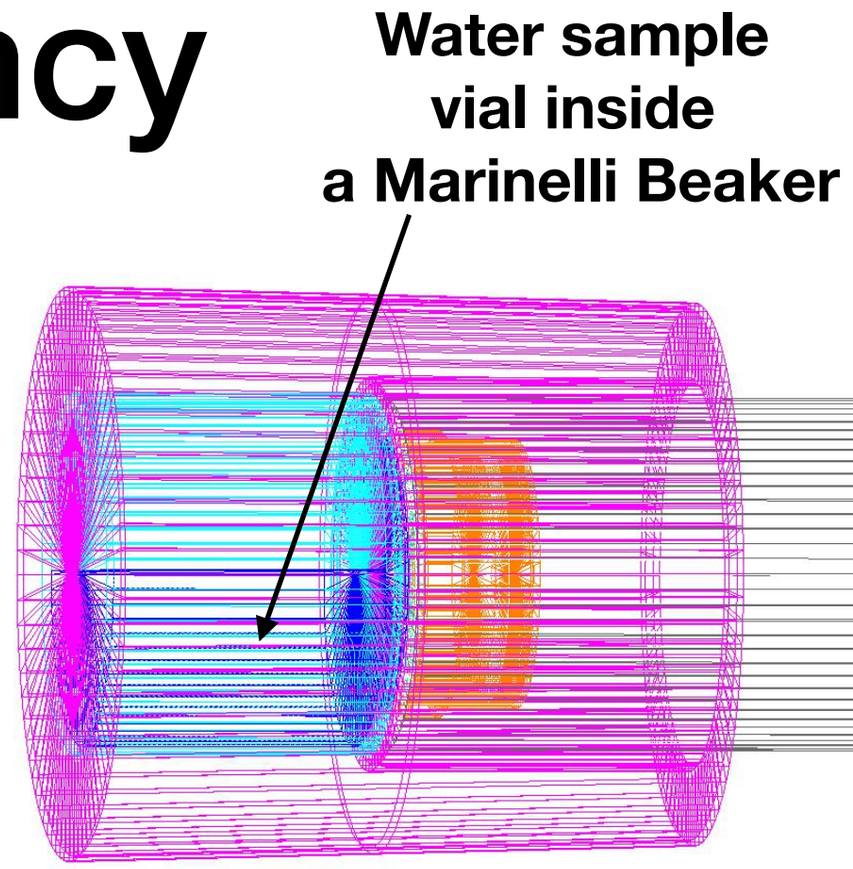


Montecarlo simulation, to extract efficiency

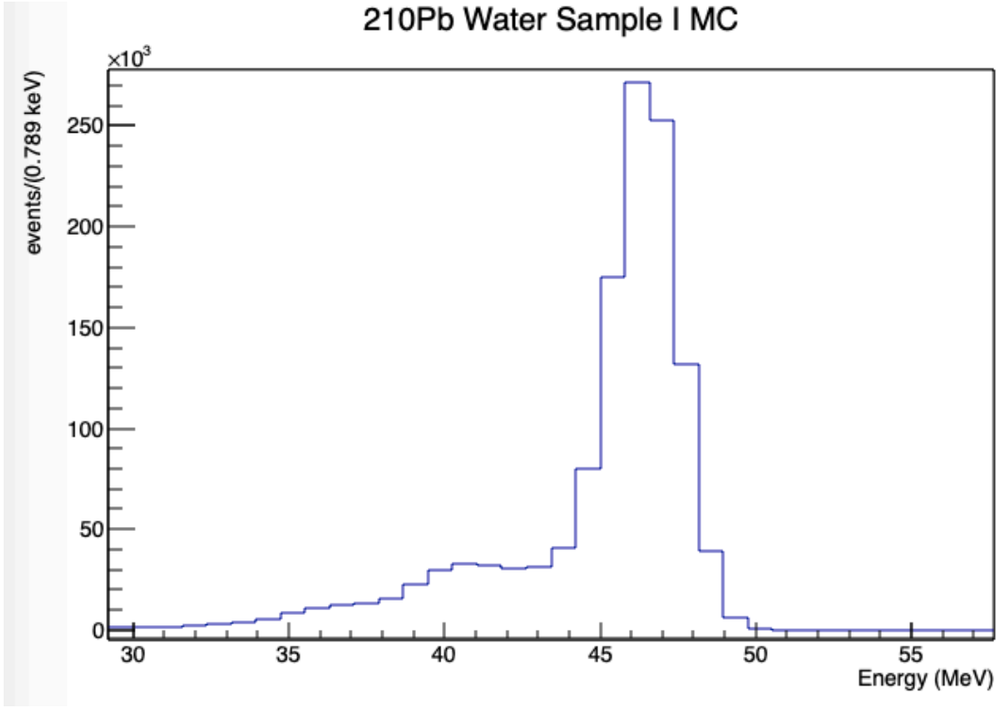
Simulated monoenergetic
46.5 keV gammas, 1keV sigma

Efficiency: Eff_MC = Npeak / Nsim

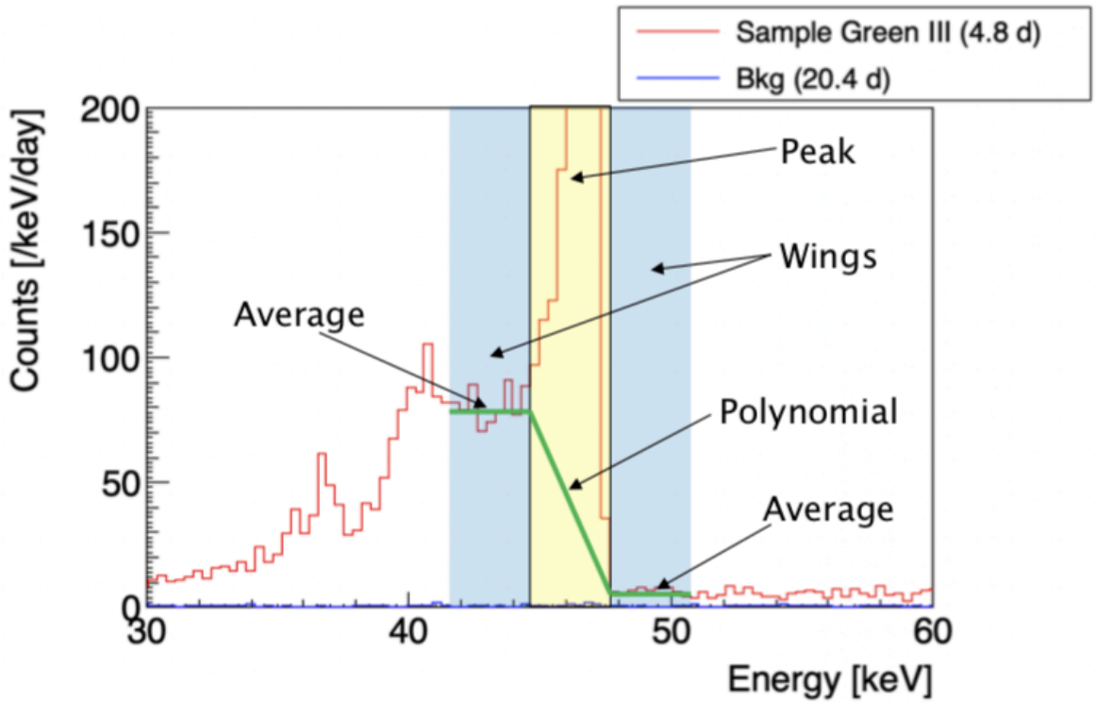
25M events simulated for each sample geometry



SAMPLE	MC efficiency %
I	3.62
II	3.60
III	3.62
IV	3.61
V	3.51
VI	3.52



Counting metod



SAMPLE VI DATA

Sample V				Background		
Channel	Energy	Counts				
136	41.344	701	649.125			
137	41.648	616			-27.046626984127	
138	41.952	635			4516.79265873016	
139	42.256	676				
140	42.56	640				
141	42.864	638				
142	43.168	647				
143	43.472	640				
144	43.776	695		622.078373015872	72.921626984128	24903.0724
145	44.08	695		595.031746031745	595.031746031745	
146	44.384	706		567.985119047618	138.014880952382	
147	44.688	769		540.938492063491	228.061507936509	
148	44.992	839		513.891865079364	325.108134920636	
149	45.296	865		486.845238095237	378.154761904763	
150	45.6	945		459.79861111111	485.20138888889	
151	45.904	1154		432.751984126983	721.248015873017	
152	46.208	1577		405.705357142856	1171.29464285714	
153	46.512	2531		378.658730158729	2152.34126984127	
154	46.816	3701		351.612103174602	3349.3878968254	
155	47.12	4684		324.565476190475	4359.43452380953	
156	47.424	4643		297.518849206348	4345.48115079365	
157	47.728	3697		270.472222222221	3426.52777777778	
158	48.032	2197		243.425595238094	1953.57440476191	
159	48.336	1077		216.378968253967	860.621031746033	
160	48.64	530		189.33234126984	340.66765873016	
161	48.944	259	162.285714285714			
162	49.248	171				
163	49.552	158				
164	49.856	151				
165	50.16	118				
166	50.464	129				
167	50.768	150				

Activity = Npeak / (eff_MC*Br)

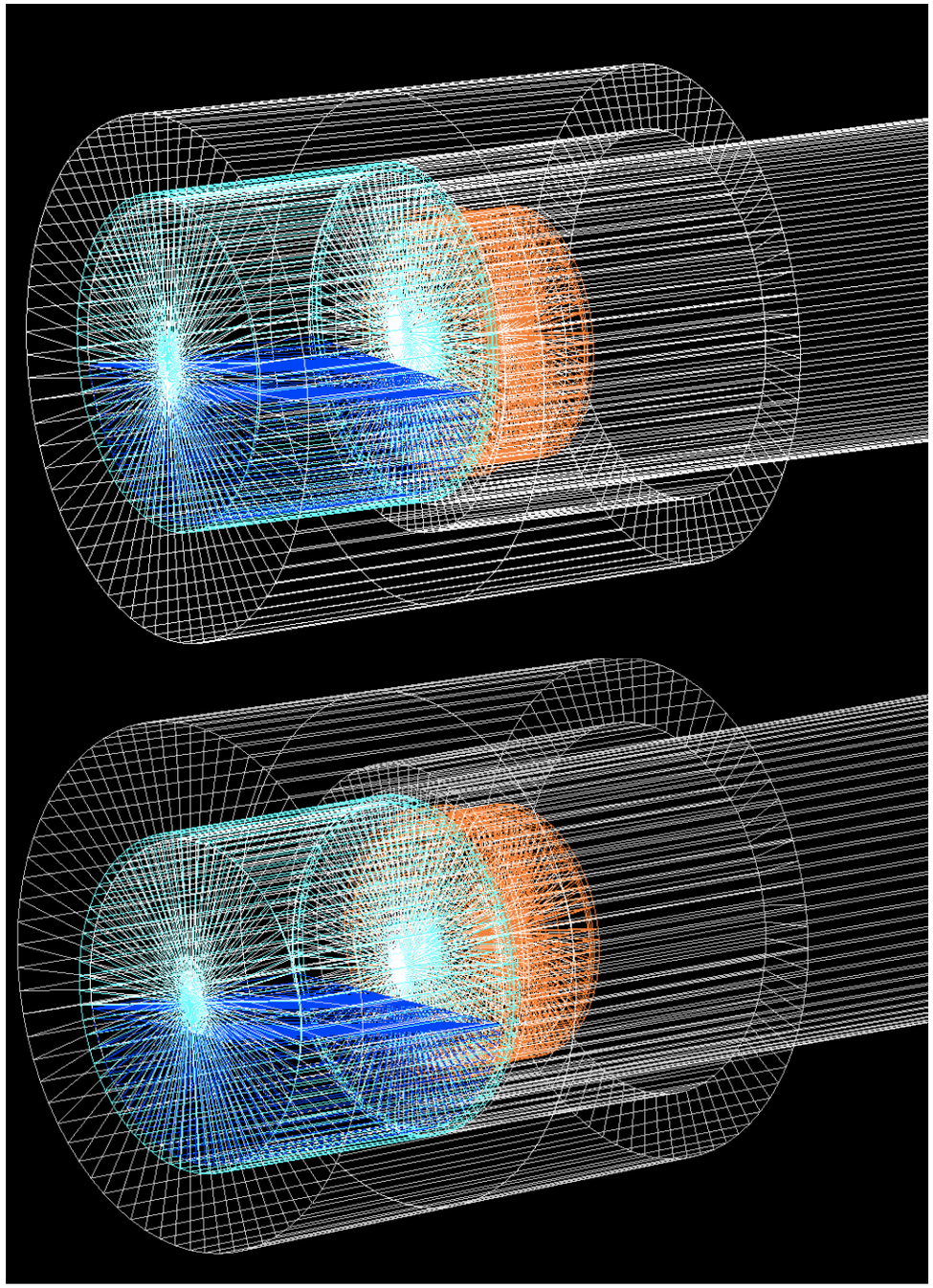
6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{1,0}$(Bi)	46,539 (1)	4,252 (40)

All tables for data and MC are attached in the Excel files

Systematic uncertainties, sample V case study

- If the relative position of the Marinelli beaker with respect to the detector is moved upwards or downwards by 4mm.
- The container thickness is 1mm thiner or thicker than measured.
- Activity measurement systematic uncertainty is 14.4%



	MC efficiency %	Change respect to nominal %
V	3.51	
V thick -1mm (MC)	3.61	-0.03
V thick +1mm (MC)	3.46	0.01
V z +4mm	3.86	-0.10
V z-4mm	3.17	0.10

Our results

	Live time (s)	Peak Counts (data) Paul's counting metod	Peak Counts (Root fit)	Counts/s	MC efficiency %	Activity (Bq)	Mass	Specific Activity (Bq/kg)	Sys error 14.8% (Bq/kg)
I	87271.97	86.84	-	0.0010	3.62	0.6872	170.75	4.0245	0.5956
II	87005.16	541.2	548	0.0062	3.60	4.3197	165.62	26.0818	3.8601
III	82285.27	369.8	495	0.0045	3.62	3.1037	177.93	17.4432	2.5816
IV	244877.44	142.9	-	0.0006	3.61	0.4041	163.57	2.4707	0.3657
V	85775.07	1062	981.35	0.0124	3.51	8.8185	124.6	70.7747	10.4747
VI	169810.25	24903	21497	0.1467	3.52	104.1562	120.45	836.5959	123.8162

Joe's

Sample Name	Live Time (s)	Specific Activity (Bq/kg)	Activity	Expected activity (168 Bq)	Ratio
Blue I Data	388692	0	0	0	0
Red II Data	89975	49.3±1.1	9.9±0.2	7.928	1.245
Green III Data	331108	42.7±0.5	8.5±0.1	4.571	1.87
Black IV Data	752191	0.054±0.013	0.011±0.003	-	-
Green V Data	68381	142±2	28.4±0.4	13.340	2.13
Blue VI Data	79178	1384±6	276.8±1.3	142.073	1.95