Visegrad Fund

Radon in thermal waters and radon risk in chosen thermal water spas in V4 countries

Final Meeting

November 27-28 2014; Bratislava, Slovakia

The Henryk Niewodniczański
INSTITUTE of NUCLEAR PHYSICS
Polish Academy of Sciences

LER
LABORATORY OF RADIOMETRIC EXPERTISE
INSTITUTE OF NUCLEAR PHYSICS PAN

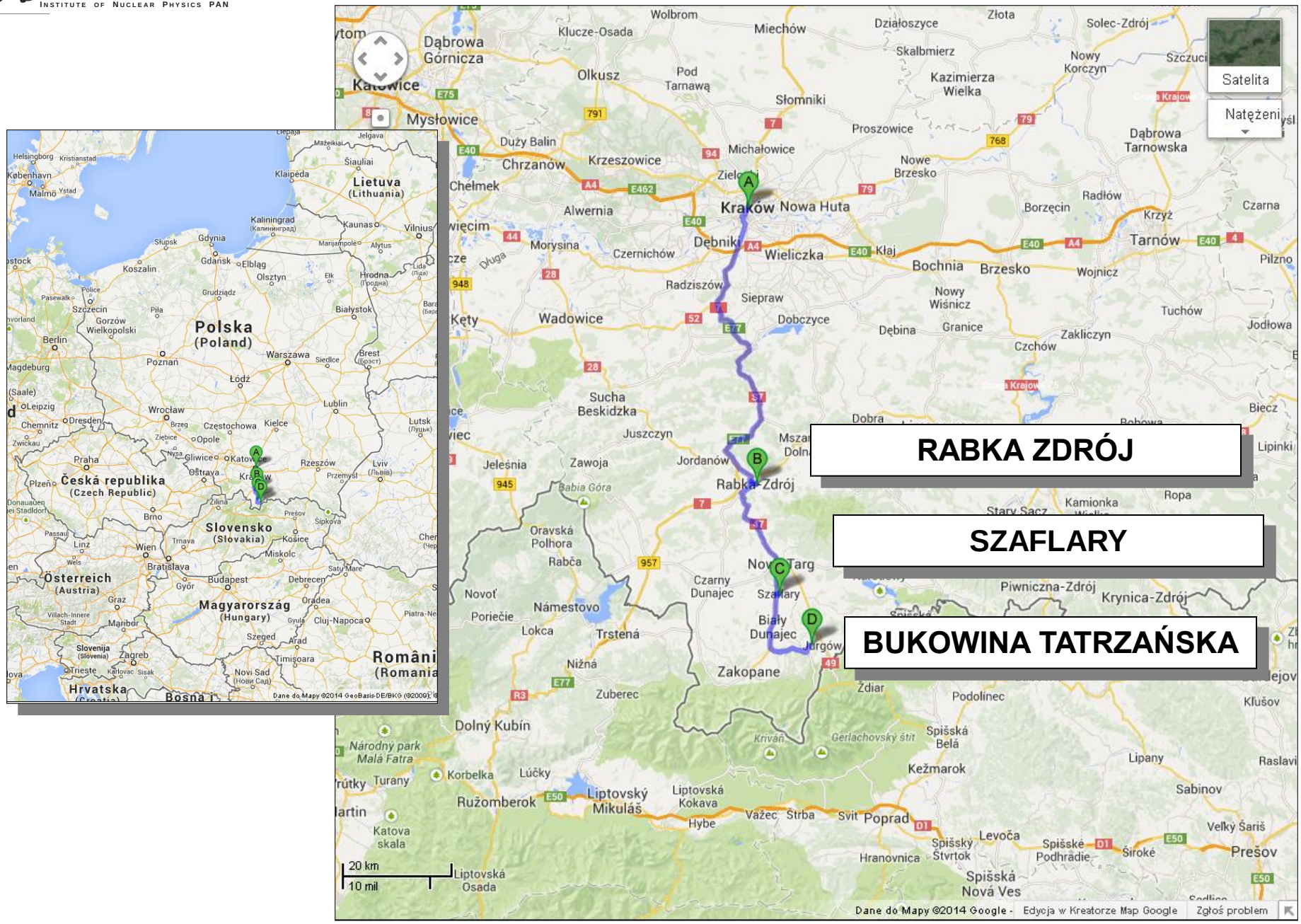
Krzysztof Kozak, Jadwiga Mazur, Dominik Grządziel, Mariusz Mroczek

Partial results from our measurements of:

- Radon concentration in the air of SPA buildings
- Radon concentration in thermal water

LER
LABORATORY OF RADIOMETRIC EXPERTISE
INSTITUTE OF NUCLEAR PHYSICS PAN

CHOSEN SPAS IN POLAND



RABKA ZDRÓJ

SZAFLARY

BUKOWINA TATRZAŃSKA

RABKA ZDRÓJ – Therapeutic SPA

salt and sulfur baths

Placing track detectors:

- Two rooms with therapeutic thermal baths (108D, 109D)

- One nurses room for background measurements (104D)

RABKA ZDRÓJ – Therapeutic SPA

Water sampling

SZAFLARY – Recreational SPA

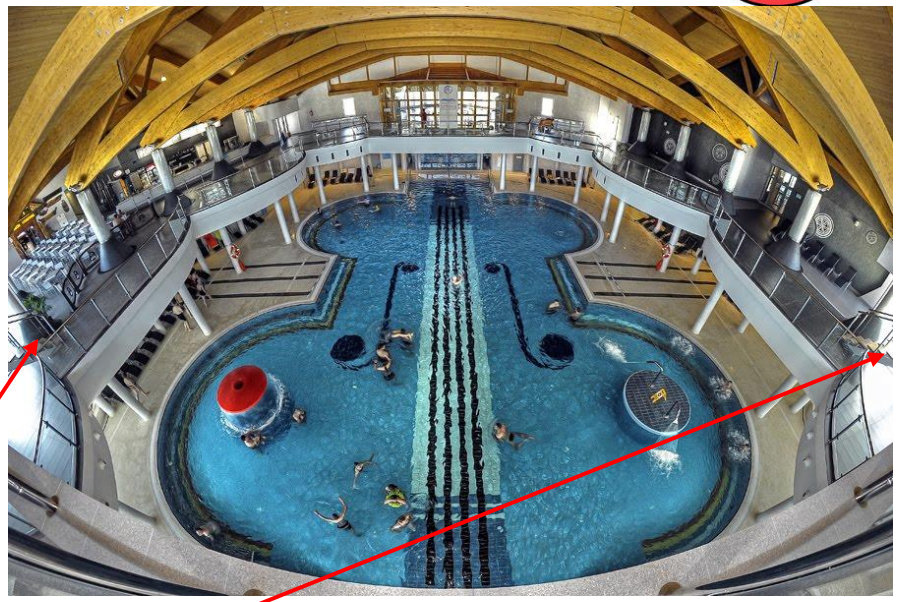
Placing track detectors:

-Open place under the slide
- Lifeguard open room
- Upper terrace
- Upper dressing room - BACKGROUND
- Lower dressing room - BACKGROUND

SZAFLARY – Recreational SPA

Water sampling

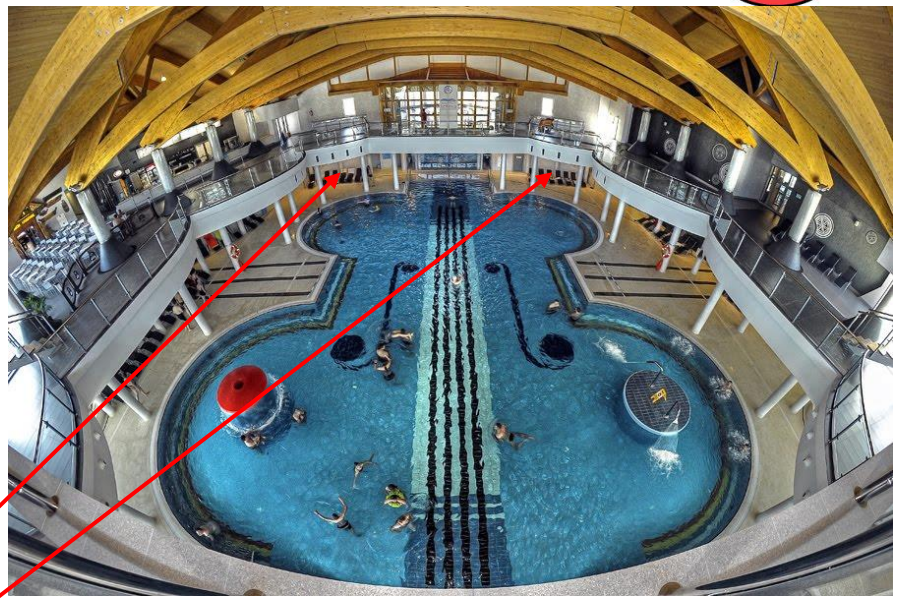
BUKOWINA TATRZAŃSKA – Recreational SPA



Placing track detectors:

- Swimming pool, upper terrace
- Swimming pool, ground
- Lifeguard room - BACKGROUND
- Children swimming pool

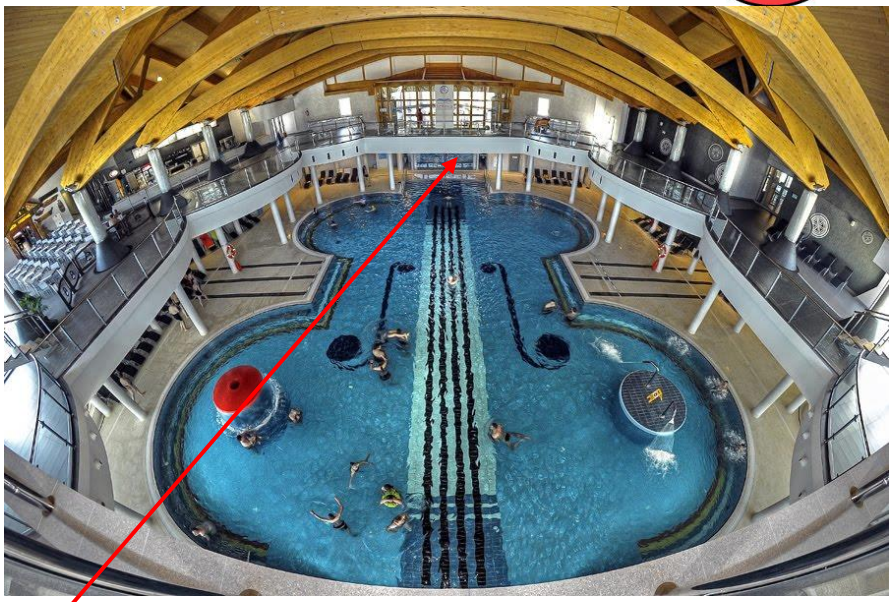
BUKOWINA TATRZAŃSKA – Recreational SPA



Placing track detectors:

- Swimming pool, upper terrace
- Swimming pool, ground
- Lifeguard room - BACKGROUND
- Children swimming pool

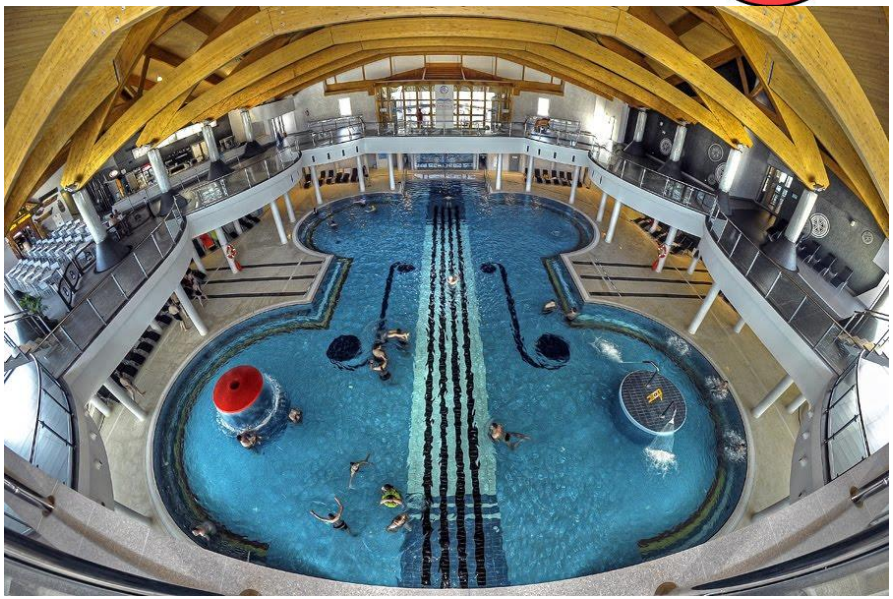
BUKOWINA TATRZAŃSKA – Recreational SPA



Placing track detectors:

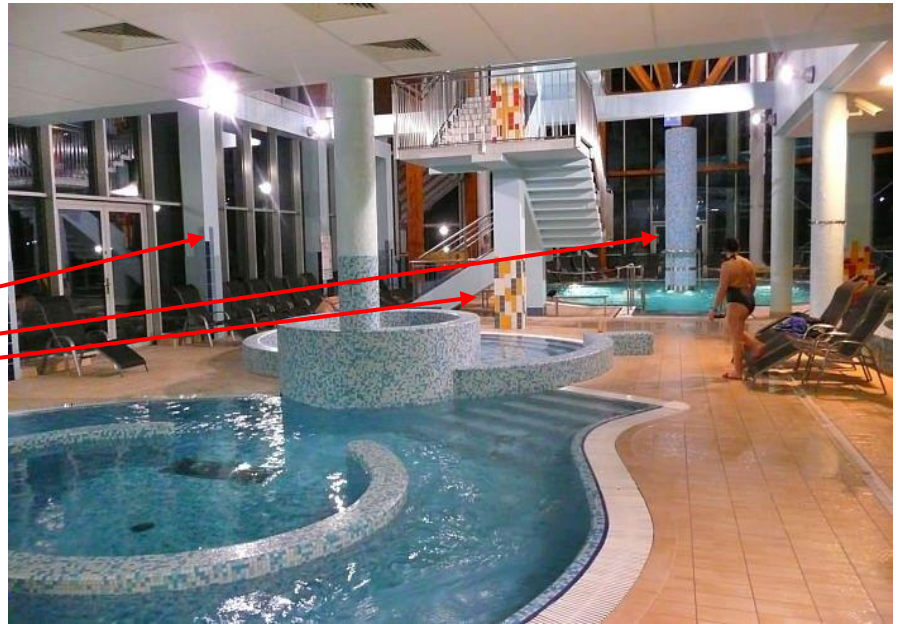
- Swimming pool, upper terrace
- Swimming pool, ground
- Lifeguard room - BACKGROUND
- Children swimming pool

BUKOWINA TATRZAŃSKA – Recreational SPA



Placing track detectors:

- Swimming pool, upper terrace
- Swimming pool, ground
- Lifeguard room - BACKGROUND
- Children swimming pool



Water sampling

Results - Rabka

	March – May 2014				June – August 2014
	Average value from all detectors	Average value from RAMARN detectors	Average value from RADUET detectors	Average value from NRPB detectors	Average value from RAMARN detectors
Place	Bq/m³				Bq/m3
Room 108D	43	25	53	62	31
Room 109D	50	33	54	70	46
Room 104D - BG	34	33	37		48

Radon concentration – results of RAMARN detectors [Bq/m³]

Rabka all rooms	I exposure	II exposure
Arithmetic Mean	30	41
Median	28	37
Standard Deviation	7	21
Minimum	25	20
Maximum	40	85

LER
Laboratory of Radiometric Expertise
Institute of Nuclear Physics PAN

Results - Szaflary

	March – May 2014				June – August 2014
	Average value from all detectors	Average value from RAMARN detectors	Average value from RADUET detectors	Average value from NRPB detectors	Average value from RAMARN detectors
Place	Bq/m³				Bq/m3
Lifeguard open room	33	28	39	37	23
Open place under the slide	43	25	51	71	37
Upper terrace	60	43	55	99	32
Upper dressing room - BG	36	30	34	45	30
Lower dressing room - BG	50	30	64	56	60

Radon concentration taken from RAMAR detectors

[Bq/m³]

Szaflary all rooms	I exposure	II exposure
Arithmetic Mean	31	34
Median	28	30
Standard Deviation	12	14
Minimum	25	20
Maximum	60	60

Results - Bukowina

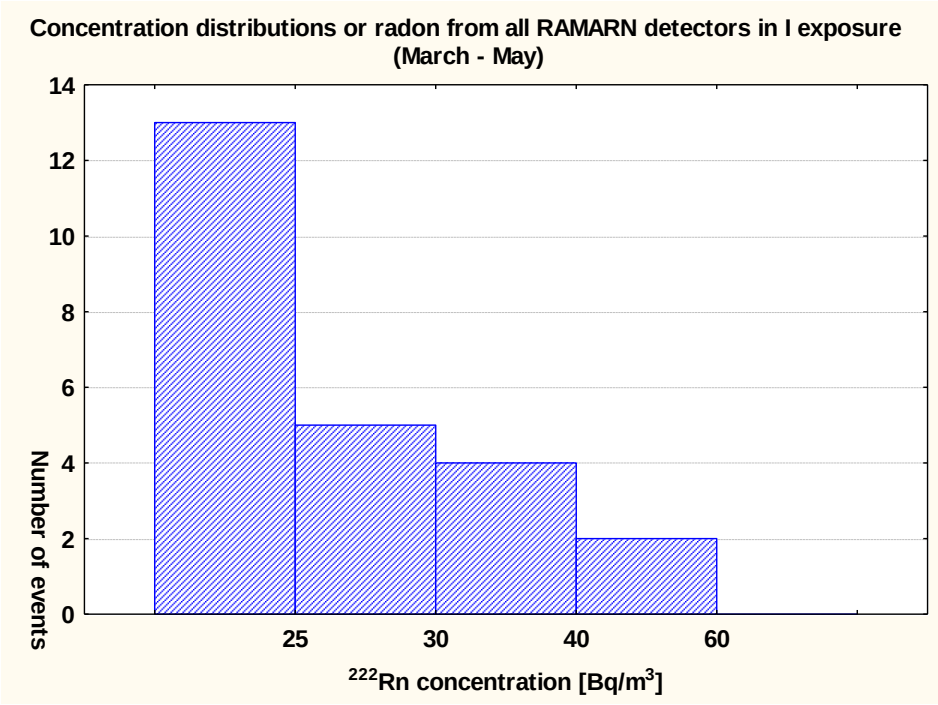
	March – May 2014				June – August 2014
	Average value from all detectors	Average value from RAMARN detectors	Average value from RADUET detectors	Average value from NRPB detectors	Average value from RAMARN detectors
Place	Bq/m³				Bq/m3
Swimming pool, upper terrace	42	50	30	40	26
Swimming pool, ground		33			20
Children swimming pool	27	25	32		20
Lifeguard room - BG	41	25	39	59	56

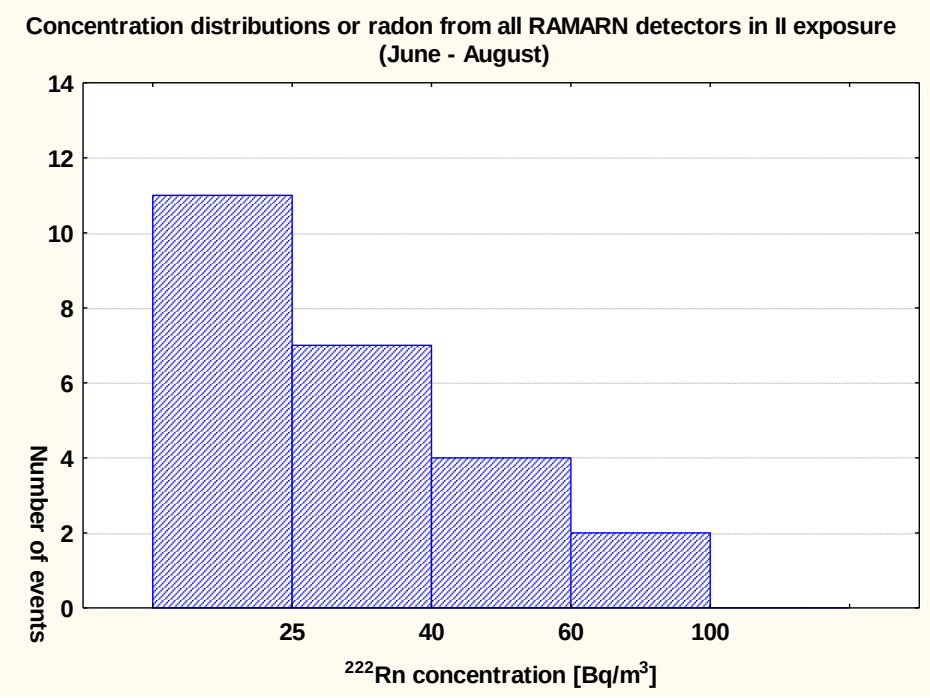
Radon concentration taken from RAMAR detectors [Bq/m³]

Bukowina all rooms	I exposure	II exposure
Arithmetic Mean	33	30
Median	25	20
Standard Deviation	13	25
Minimum	25	20
Maximum	60	92

Results from all RAMARN detectors

Statistical Analysis	I exposure	II exposure
	Bq/m^3	
Arithmetic Mean	31	35
Median	25	28
Standard Deviation	10	20
Minimum	25	20
Maximum	60	92

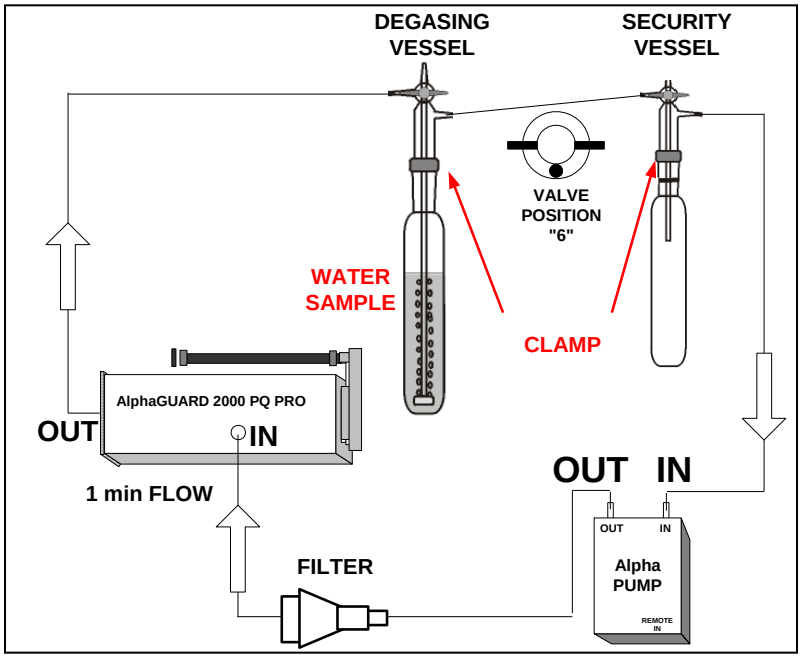




Radon in water – measuring methods

LSC Method

AquaKIT Method



LER
Laboratory of Radiometric Expertise
Institute of Nuclear Physics PAN

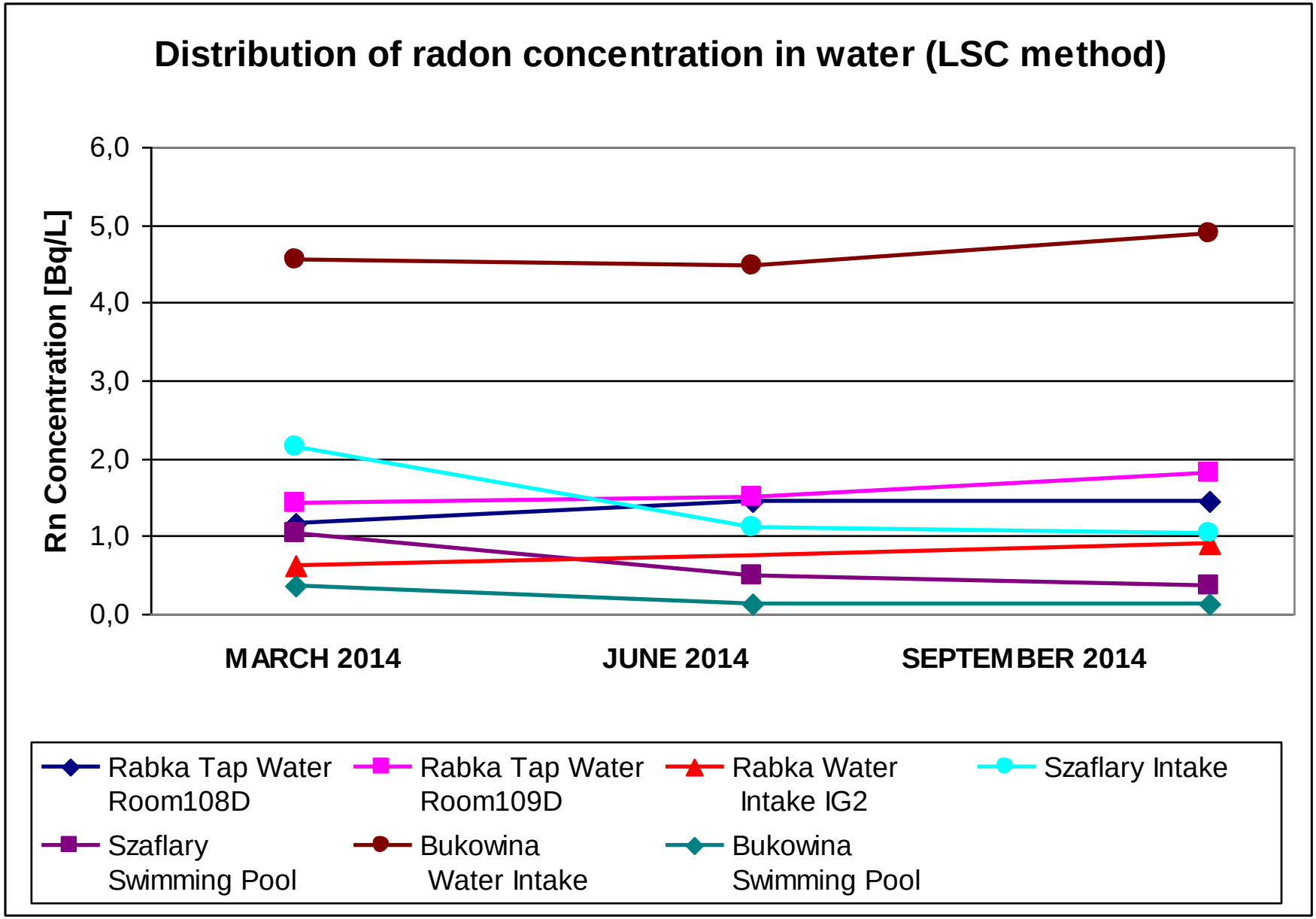
Results from water samples

March	LSC		AG		Percentage Difference
Place of Sampling	Rn [Bq/L]	Error [Bq/L]	Rn [Bq/L]	Error [Bq/L]	
Rabka Tap Water Room108D	1,2	0,1	1,3	1,2	8%
Rabka Tap Water Room109D	1,4	0,1	1,6	1,3	13%
Rabka Water Intake IG2	0,6	0,1	1,3	1,2	54%
Szaflary Intake	2,2	0,1	2,8	1,7	21%
Szaflary Swimming Pool	1,0	0,1	1,1	1,3	9%
Bukowina Water Intake	4,6	0,4	3,9	2,1	18%
Bukowina Swimming Pool	0,4	0,03	0,7	1,4	43%

September	LSC		AG		Percentage Difference
Place of Sampling	Rn [Bq/L]	Error [Bq/L]	Rn [Bq/L]	Error [Bq/L]	
Rabka Tap Water Room108D	1,5	0,1	2,0	1,2	25%
Rabka Tap Water Room109D	1,8	0,1	1,9	1,1	5%
Rabka Water Intake IG2	0,9	0,1	0,8	0,8	13%
Szaflary Intake	1,0	0,1	1,0	0,9	0%
Szaflary Swimming Pool	0,4	0,1	0,5	0,7	20%
Bukowina Water Intake	4,9	0,1	4,5	1,9	9%
Bukowina Swimming Pool	0,1	0,02	0,2	0,4	50%

June	LSC	
Place of Sampling	Rn [Bq/L]	Error [Bq/L]
Rabka Tap Water Room108D	1,4	0,1
Rabka Tap Water Room109D	1,5	0,1
Rabka Water Intake IG2		
Szaflary Intake	1,1	0,1
Szaflary Swimming Pool	0,5	0,1
Bukowina Water Intake	4,5	0,2
Bukowina Swimming Pool	0,1	0,03

Results from water samples



Results from water samples

Statistical data from all places and LSC method

Statistical Analysis	March	June	September
	Bq/L		
Arithmetic Mean	1,6	1,5	1,5
Median	1,2	1,3	1,0
Standard Deviation	1,4	1,5	1,6
Minimum	0,4	0,1	0,1
Maximum	4,6	4,5	4,9

…and it's all for now…

Thank you for your attention!