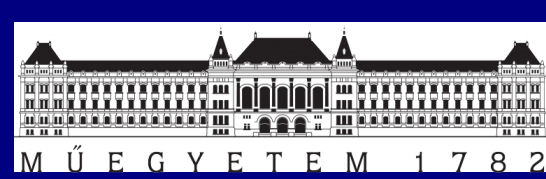


IMPACT OF THE 10 YEAR NATIONAL TEACHER PROGRAMMES ORGANISED FOR HUNGARIAN PHYSICS TEACHERS AT CERN

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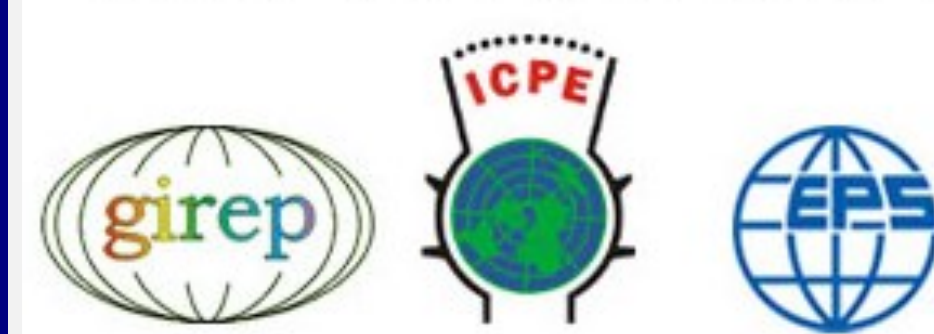


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INTRODUCTION

National Teachers' Programmes in national languages (2006—2015)



To be the first who join the NTP (HTP) program



AIM

- To train and help teachers to teach particle physics in high school
- To promote and help exchange of the educational methods at international level
- To share and present teachers the world of research
- To promote physics in and outside the classroom
- to increase and promote schools cooperation with CERN



METHOD

- one-week training program at CERN
- lectures
- laboratory visits
- cooperation based measurements
- computer aided measurements.

SELF-EMPLOYED WORK (COOPERATION), COMPUTER-AIDED MEASUREMENTS

DEPENDENCE OF THE BOILING POINT OF WATER ON THE AIR PRESSURE



h	Quality of water	Air pressure	boiling point with alcoholic thermometer	boiling point with electric thermometer
489 m	Water	979,5 HPa	96 °C	100 °C
489 m	Distilled water	979,5 HPa	97 °C	101, 2 °C

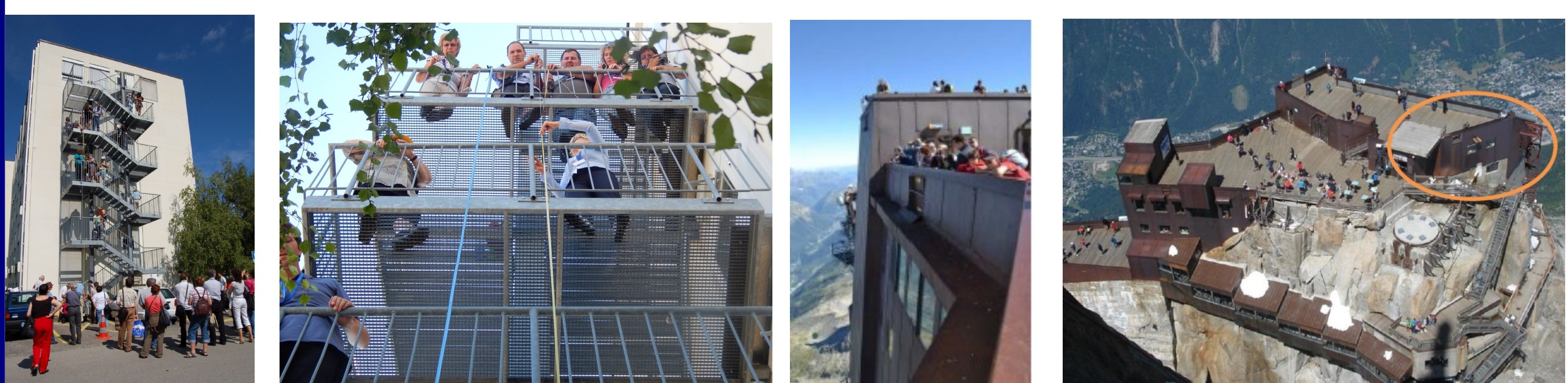
RESULTS

h	Quality of water	Air pressure	boiling point with alcoholic thermometer	boiling point with electric thermometer
3842 m	Water	653 HPa	86 °C	90 °C
3842 m	Distilled water	653 HPa	87 °C	94 °C

PAPERS



TORRICELLI'S EXPERIMENT WITH WATER (AND WITH WINE)



Torricelli in CERN

- Place: Building 32: fire escape stairs
- 1st method: coloured water
- 28 °C, 96,5 kPa (official value)
- Our results: $p_0 = \rho \cdot g \cdot h$

$$p_0 = 997 \frac{\text{kg}}{\text{m}^3} \cdot 9,81 \frac{\text{m}}{\text{s}^2} \cdot 9,2 \text{ m} = 89981 \text{ Pa} (\approx 90 \text{ kPa})$$

- Errors: bubbles, saturated vapor in space

Torricelli at Aiguille du Midi

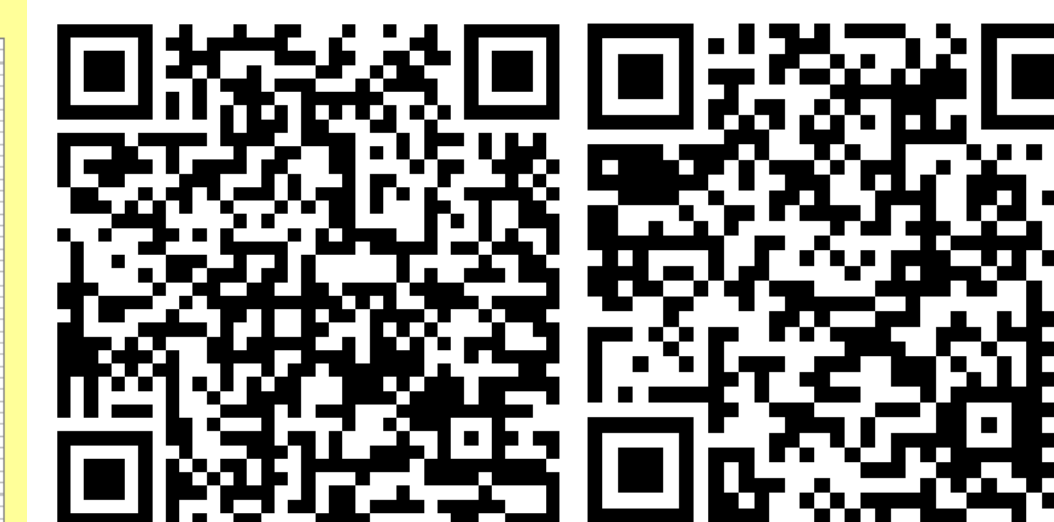
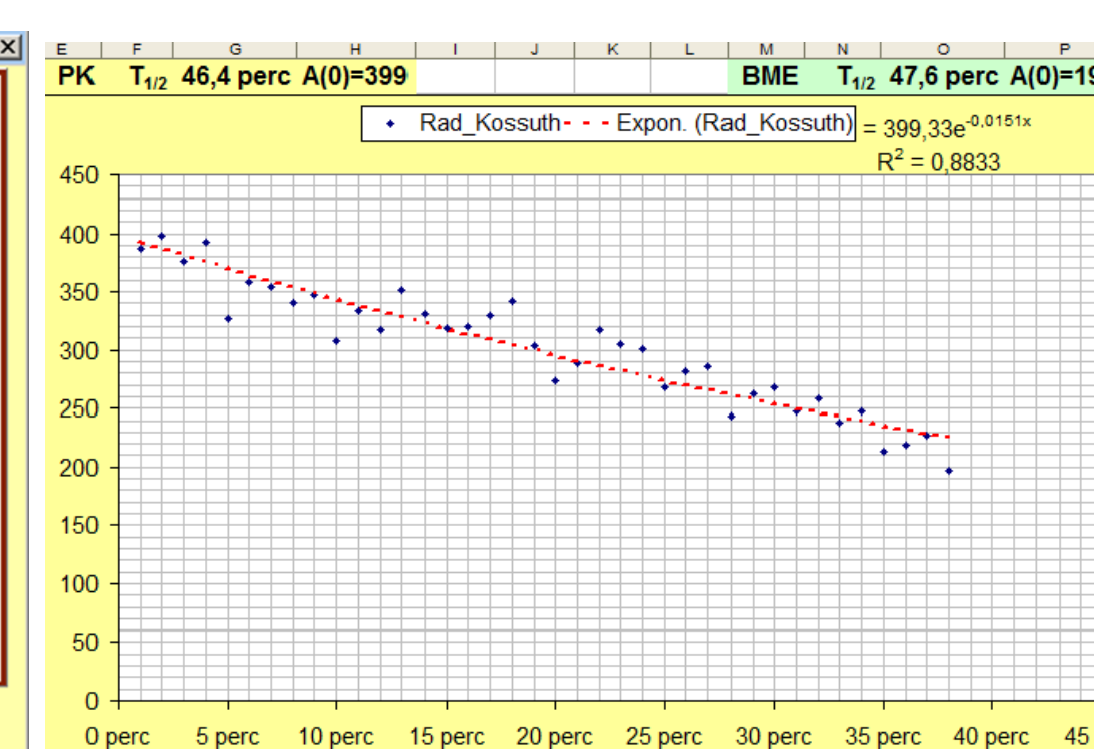
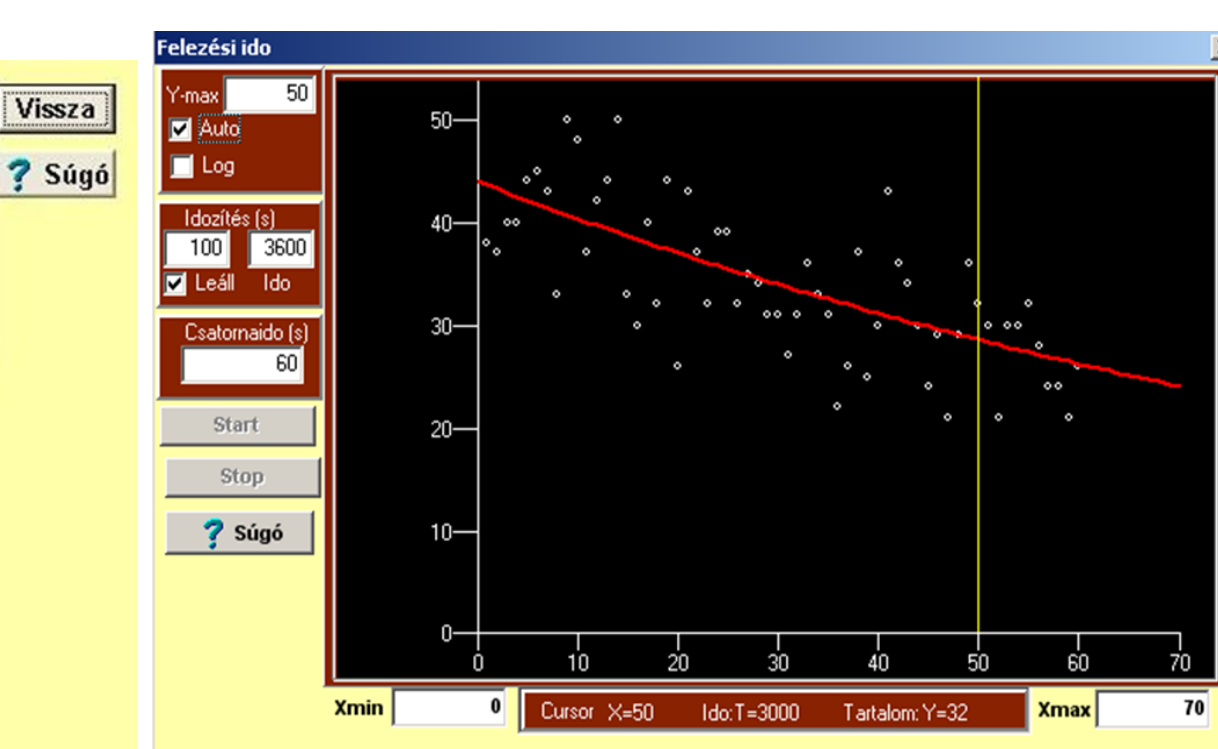
- 2nd method: coloured water
- 2 °C, 64,5 kPa (official value)
- Our results:

$$p_0 = 1000 \frac{\text{kg}}{\text{m}^3} \cdot 9,81 \frac{\text{m}}{\text{s}^2} \cdot 6,22 \text{ m} = 61 \text{ kPa}$$

- Saturated vapor on 15 °C, $p=1,7 \text{ kPa}$



MEASURING THE RADON CONCENTRATION IN AIR USING A VACUUM CLEANER (IN A CELLAR)



GEO-LOCATION USING THE SUN (AT DIFFERENT PLACES DURING THE TRAVEL)



Nr.	Date 2013	High noon	Stick height	Length of shadow	$\tan \alpha$	$\arctan \alpha$	α	Declination
1.	21 July	12:50	30,0 cm	14,30 cm	0,4767	0,4448	25,49°	20,5°
2.	16 August	13:49	30,0 cm	19,10 cm	0,6367	0,5669	32,48°	13,1°
3.	16 August	13:53	23,2 cm	15,70 cm	0,6767	0,5949	34,09°	13,1°
4.	17 August	13:38	30,0 cm	19,20 cm	0,6400	0,5693	32,62°	12,9°
5.	25 August	12:42	42,5 cm	31,70 cm	0,7459	0,6409	36,72°	10,5°

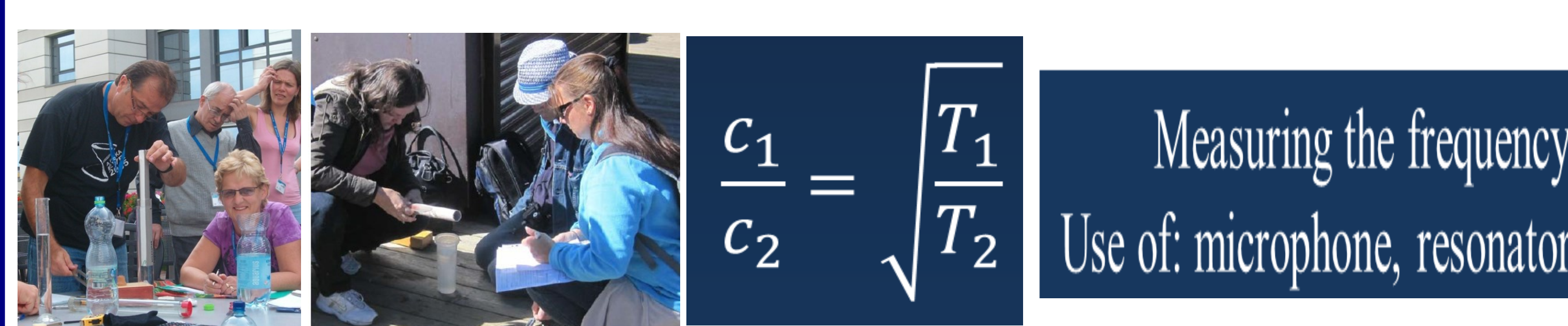
Nr.	Date 2013	Time of highest Sun	GMT-X	High noon	Time correction (min)	Corrected time (min)	Corrected angle	Time zone
1.	21 July	12:44	2	104	-6,5	97,5	24,38°	45°
2.	16 August	13:49	2	169	-4,1	164,9	41,23°	45°
3.	16 August	13:53	2	173	-4,1	168,9	42,23°	45°
4.	17 August	13:38	2	158	-3,9	154,1	38,53°	45°
5.	25 August	12:42	2	102	-2,2	99,8	24,95°	45°

Measured latitude	GPS	GPS (+)	Difference	Place of measurements
45,98558146°	46,67703°	3 m	0,69°	Békéscsaba
45,58354851°	46,23012°	3 m	0,65°	CERN (39)
47,18716063°	46,23171°	3 m	-0,96°	CERN (main b.)
45,51924307°	45,90148°	3 m	0,38°	Aiguille du Midi
47,21860775°	47,59279°	3 m	0,37°	Solymár

Measured Geographic length	GPS	GPS (+)	Difference	Place of measurements
20,63°	21,08487°	3 m	0,46°	Békéscsaba
3,78°	6,05442°	3 m	2,28°	CERN (39)
2,78°	6,05442°	3 m	3,28°	CERN (main b.)
6,48°	6,88528°	3 m	0,41°	Aiguille du Midi
20,05°	18,93841°	3 m	-1,11°	Solymár



DEPENDENCE OF THE SPEED OF SOUND ON THE TEMPERATURE OF THE AIR (MEASUREMENT MADE WITH SMART PHONE)

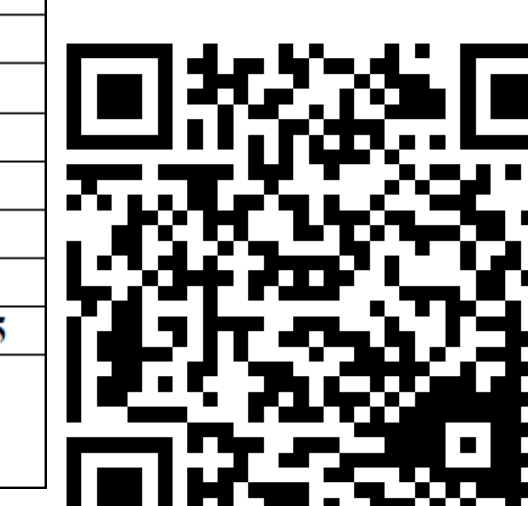


$$\frac{c_1}{c_2} = \sqrt{\frac{T_1}{T_2}}$$

Measuring the frequency in resonator,
Use of: microphone, resonator spectrum analyser



CERN		Mont Blanc		
$t_f=25^{\circ}\text{C}$, $\lambda_f=0,6041\text{m}$		$t_f=2,5^{\circ}\text{C}$, $\lambda_f=0,6041\text{m}$		
$f(\text{Hz})$	$c=\lambda_f \cdot f(\text{m/s})$	$f(\text{Hz})$	$c=\lambda_f \cdot f(\text{m/s})$	
578	349,1	564	340,7	
578	349,1	564	340,7	
578	349,1	564	340,7	
-	-	562	339,5	
-	-	563	340,1	
Average+ Empirical standard deviation		$c_1=349,1\pm0,9$ * $c_2=340,3\pm0,5$		
Comparison		$\sqrt{\frac{T_1}{T_2}}=1,040$; $\frac{c_1}{c_2}=1,025\pm0,001$		
Measured value from literature		346,9		333,5
Difference between measured value and published value		2,2 m/s; (0,63%)		6,8 m/s; (2,03%)



MEASURING THE RADIATION BACKGROUND (EFFECT OF THE COSMIC RADIATION)

- certified dose intensity meter

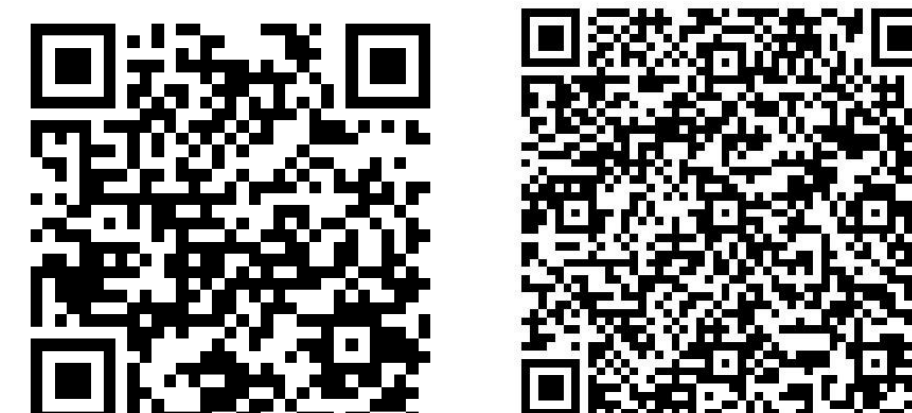
Places	North latitude	East longitude	Height above sea level	Day	Time	nSv/h	Error %
CERN	46° 12'	6° 8'	423	16	9:00	90,5	5
CERN	46° 12'	6° 8'	423	16	10:00	97,8	5
CERN	46° 12'	6° 8'	423	16	11:00	94	5
CERN	46° 12'	6° 8'	423	17	9:00	89,5	4
CERN	46° 12'	6° 8'	423	18	9:00	99,9	4
CERN	46° 12'	6° 8'	423	18	10:00	84,8	4
CERN 40	46° 12'	6° 8'	413	19	8:12	68	5
CERN 40	46° 12'	6° 8'	413	19	9:30	69,9	5
Chamonix	45° 50'	6° 51'	1035	20	16:30	153	5
Chamonix	45° 50'	6° 51'	1035	20	17:00	150	5
Aiguille du midi	45° 55'	6° 51'	3842	20	11:00	243	5

CONCLUSIONS

- teachers performed many computer assisted experiments,
- teachers do the experiments with pleasure,
- teachers BYOD and get more motivated in collaboration,



REFERENCES



RESULTS

- more than 400 teachers, 300 students took part in one-week training program in CERN

