

Contents

Introduction	6
Acknowledgements	8
1 School radiation sources	9
1.1 School radiation source (ŠZZ Alfa)	9
1.2 Demonstrational source of radiation (DZZ Gama)	11
2 Pixel detector MX-10	13
2.1 The principle of detection of ionizing radiation	13
2.2 The Simple Preview program	17
3 Demonstrations and laboratories using MX-10	22
3.1 Demonstration of uranium glass radioactivity	22
3.1.1 Visualization of the tracks of different types of IR (Uranium)	22
3.1.2 The kinetic energy absorbed in the sensor and particle speeds (Uranium)	26
3.2 Demonstration of thorium welding rod radioactivity	29
3.2.1 Visualization of the tracks of different types of IR (Thorium)	29
3.2.2 The kinetic energy absorbed in the sensor and particle speeds (Thorium)	31
3.3 Demonstration of ^{40}K potassium radioactivity	33
3.3.1 Visualization of the tracks of different types of IR (Potassium)	33
3.3.2 The kinetic energy absorbed in the sensor and particle speeds (Potassium)	35
3.4 Experiments with ^{241}Am using ŠZZ Alfa and DZZ Gama	36
3.4.1 Visualization of the tracks of different types of IR (Americium)	36
3.4.2 Particle beam collimation	40
3.4.3 The histogram of alpha particle track sizes	42
3.4.4 The statistical nature of radioactive decay	46
3.4.5 Poisson distribution	47
3.4.6 Alpha particle energies	50
3.4.7 The absorption of alpha particle energy in the air	53

3.4.8	The absorption of alpha particle energy in air – energy histogram assessment	55
3.4.9	The influence of the source particle output on detected alpha particle spectrum	58
3.4.10	Approximate estimation of the mean linear range of alpha particles in the air	59
3.4.11	The absorption of alpha particles in paper and other thin layers	61
3.4.12	The absorption of alpha particles in the plastic food wrapping foil	62
3.4.13	The absorption of alpha particles in the food wrapping foil in an inclined direction	65
3.4.14	The deceleration of alpha particles in the food wrapping foil	66
3.4.15	Alpha particles pass through porous paper	68
3.4.16	Change of the thickness of the foil when stretched	71
3.4.17	Why are soap bubbles bursting?	73
3.4.18	The absorption of alpha particles in water	75
3.4.19	Is aluminum foil thinner than a human hair?	77
3.4.20	The loss of alpha particle energy in air	79
3.4.21	Bragg curve	85
3.4.22	Dependence of the number of detected particles alpha on the distance from the source	88
3.4.23	Visualization of gamma photon tracks	94
3.4.24	Energies of gamma photons	96
3.4.25	Does detected photon energy depend on distance from source?	100
3.4.26	Dependence of the number of detected photons on the distance from radiation source	104
3.4.27	Absorption of gamma radiation in metals	106
3.4.28	Radiography	109
3.4.29	X-ray fluorescence analysis	113
3.5	The natural background radiation	118
3.5.1	The composition of radioactivity measured in the air	118
3.5.2	Radon in the environment	120
3.5.3	The radioactivity of radon in the air, measured in a common household	122
3.5.4	Filtering air using a vacuum cleaner	125
3.5.5	The exponential law of radioactive decay	129
3.5.6	X-ray radiation of a CRT screen	132
3.5.7	Alpha radiation and a CRT	134

3.5.8	Cosmic rays	137
3.5.9	Muons come from above	137
3.5.10	Visualization of radiation background onboard an airplane	141
3.5.11	Changes of the particles rate during flight	143
3.5.12	Analysis of flight from the perspective of dosimetry quantities	145
3.6	The radiation in orbit	147
	Appendix: The quantities and units of atomic and nuclear physics	150

Bibliography	152
-------------------------------	------------