Z39(X3) - X Ray Dosimetry

Physics Laboratory II – academic year 2017/2018
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The aim of this experiment is to present the radiation dose units and calculation of dose rates as well as the method of their measurement based on the ionization properties of X-rays. Additionally the imaging of blood vessel model with contrast medium will be performed.

Preparatory questions

- X radiation and its interaction with matter [1, 2];
- elements and characteristics of X-ray lamp;
- ionization, energy of ionization [1, 2];
- definitions and methods of calculation of radiation doses (committed, absorbed, equivalent, effective dose) [1, 2];
- dosimeter;
- Bremsstrahlung [1, 2];
- absorption law [1, 2];
- contrast medium.

Computational assignments

Calculate effective dose of radiation for person standing for $T[h]$ in the distance of $d[m]$ from point-like source of ^{22}Na with activity of $A[Bq]$.

Apparatus and materials

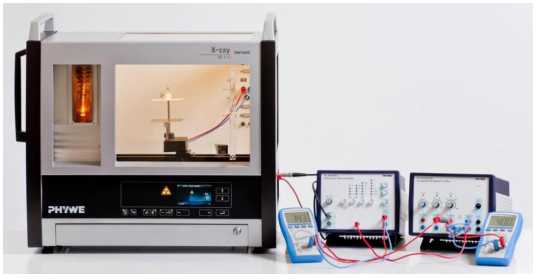

Figure 1: Dosimetry

Dosimetry:

- X-ray unit,
- amplifier,
- high voltage unit,
- 2 digital multimeters,
- capacitor.
- connecting cords.

Imaging of blood vessel model:

- X-ray unit,
- blood vessel model,
- 2 syringes,
- potassium iodide,
- tube connectos,
- fluorescent screen,
- camera.

Figure 2: Imaging

Experiment

Dosimetry: measurement of discharge time of the electroscope for a) different voltages of the anode with $5kV$ step and constant current (max. value of $1mA$); b) different currents with $0.1mA$ step and constant voltage (max. value $35kV$). Imaging: investigation of elements contrast in the image of blood vessel model for different currents and voltages of the anode.

Data analysis

- Calculate the irradiated capacitor volume in an approximate manner based on the measurements of positions of the experimental setup elements.

- Plot the value of current in the capacitor as a function of used voltage. Perform the measurement series with two diaphragm tubes with different aperture diameters. Determine saturation region. Calculate radiation dose (the mean ionization energy of air molecule is $33eV$).
- Plot the ionization current as a function of the anode voltage. Determine range of current and anode values when the X-rays are not generated in the unit.

References

[1] W.R. Leo, *Techniques for nuclear and particle physics experiments*, S.-Verlag 1987.

[2] K. S. Krane, *Introductory Nuclear Physics*, John Wiley & Sons