Modeling of the radiation situation in the rooms at BNCT research post using the MCNP code.

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In the National Centre for Nuclear Research in Świerk a research post for Boron Neutron Capture Therapy is created. The source of neutrons for research is the MARIA research reactor. The neutron beam will be led from the reactor core through the intermediate channel and the H2 channel to the irradiation room. The H2 channel is located in the concrete wall between the reactor pool and the research room. The intermediate channel has already been installed in the MARIA reactor pool, which is a great step towards starting the research into the therapy. The project assumes obtaining a beam of neutrons with thermal, epithermal and fast energy of the expected intensity of 10^9 n/s/cm^2.

The reactor works according to the schedule based on radiopharmaceutical isotopes production, therefore it cannot be easily turned on and off. In order to cut the beam off to allow safe entrance to the irradiation room, a Beam Shutter will be installed. Before starting the research, it is necessary to assess the radiation situation in the rooms in the planned laboratory and to design radiation shielding in order to ensure safe working conditions. For this purpose, a three-dimensional model of rooms was created in the MCNP (Monte Carlo N-Particle Transport Code System) program.

The MCNP code is used to analyze the transport of neutrons and photons. The calculations were made assuming that the power of the working reactor is equal to 25 MW and the intermediate channel and H2 channel are open. The calculations made it possible to determine the spatial distribution of neutron and photon flux in all research rooms and to present the results using three-dimensional maps. The 3D maps of the neutron and photon flux allowed to assess the intensity of the radiation field in each place in the modeled laboratory. Additionally thirteen cubic cells with an edge of 20 centimeters were defined in the most important spots in the laboratory. The cells played the role of ideal detectors in which the particle flux and the dose of ionizing radiation were calculated. The calculated values of flux and equivalent dose at chosen points in the rooms will be compared with the results of planned measurements. This comparison will provide preliminary information needed to design appropriate radiation shielding in the research rooms.