Objectives

The main objective of this project is **to enhance the knowledge on processes of physics and biology nature that occur in a biological material during radiotherapy,** for which measured physical parameters include radiation spectrum and radiation dose and the biological parameters are intercellular damage (damage to DNA) and proliferation ability.

Particular research aims are:

(1) **to determine the spectrum of radiation and radiation doses** absorbed in special phantoms outside the radiation field (outside the tumor) during radiotherapy;

(2) **to verify *in vitro* the scale and type of biological response of cells** placed in various places in the phantoms for used energy of radiation and irradiation techniques.

Methodology

Authors will **investigate beam energy spectrum out-of-field** (out-of tumour) **and the biological response of cell lines** (including breakdown type of normal cell lines), which were positioned in the phantom to represent the most radiosensitive organs at risk that will be evaluated. The dose outside the beam is absorbed from scattered radiation that were produced during interactions.

The spectrum of radiation will be studied using so called Monte Carlo calculation methods, taking into account the localisation of all sources of scattered radiation. Knowing **the energy spectrum will lead to a determination of correction coefficients needed in dose measurements** and **will allow verification of dose calculation algorithms** and measurement procedures.

The qualitative and quantitative evaluation of cellular breakdown will lead **to the evaluation of biological effects of doses absorbed from scattered radiation**. To assess radiosensitivity of cell population, we will perform clonogenic assay and analysis of type of cells death. In the next part of the project, we are going to evaluate the type of cell damages (precisely, the DNA breaks), which may be associated with the spectrum of the radiation (energy and type of particles/photons**). The planned experiments have innovative character considering complex methodology of dose and biological response determination in the range of doses 0.05 to few Gys for the volumes lying out-of tumor**.

Experiments will be carried out in phantoms specially designed to simulate organs of different shape and density. The different radiotherapy techniques will be evaluated.

The results of investigations within the range of doses 0.05 to few Gys for the volumes lying out-of tumor will broaden the knowledge on basic processes that occur in organism during irradiation. Deeper knowledge on the processes is required by introduction to radiotherapy of new technologies, which allow on uniform, precise and high dose to the tumour. However, due to the characteristics of radiation, higher doses in tumour lead to a greater body volume to be exposed to radiation**. Enhanced knowledge on processes on cell level will enable sparing body from exposure or better modelling the biological response**, which benefits in decreased risk of secondary cancers and potential heart diseases, cataract or digestive and respiratory system deterioration.