Abstract
Particle accelerators are used in medicine for nearly 100 years. Humanity did not have accurate knowledge about possible "side effects" of using high-energy charged particle beams back when the accelerators were introduced. With time, the increasing awareness of plurality of nuclear reactions forced the scientific community to research on the secondary reactions spotted while using ionizing radiation, yet topic still has many questions that need to be answered. Medical Aperture Companies constantly improve their technologies, when scientific and medical communities develop new methods and appliations for already existing accelerators. These factors imply that the topic of secondary radiation near medical accelerators is still far from being completely examined. **AIM OF WORK:** The intention of this work was to determine the quality and quantity of secondary radiation observed in proximity of accelerators used for medical purposes - radiation which was not intended to be produced by the given accelerator primarily, by default. Focus of the study was put on the neutron radiation, due to the challenges in its detection and proper evaluation, which occurs when non-charged particles interact with matter. The creation of this work was also motivated by the will to find new applications for secondary radiation and the need to minimize the harmful effect of ionizing radiation, due to Radiological Protection policies. **METHODOLOGY:** The experiments taken used methods such as neutron activation analysis, gamma spectroscopy and computer simulations (based on Monte Carlo experiments). For every experiment taken, the suitable experimental set was created, consisting of appropriate radiation detectors. Several studies were taken in cooperation with Maria Sklodowska-Curie National Research Institute of Oncology, Gliwice, Poland. **RESULTS:** The spatial distribution of neutron radiation during the radio-pharmaceutical cyclotron irradiation, with distinction depending on particle energy, was obtained. Furthermore, an innovative method of detection of slow-neutron particles was invented, moreover, the possible production of radioisotopes potentially useful in nuclear medicine (^{117m}Sn, ^{186}Re, ^{188}Re) during therapeutic photon beam irradiation was introduced. The transmission of neutron radiation through the shielding doors of the cyclotron bunker was also checked and the gamma radiation spectrum was measured at various measuring points in the cyclotron's vicinity. The results were subjected to statistical evaluation and confronted with other scientific reports on the subject.