Contribution ID: **324** Type: **Oral**

Study of the yield of positron emitters after irradiation with 100 and 200 MeV protons of natural calcium targets

Tuesday 2 July 2024 12:45 (15 minutes)

The most powerful means of achieving high conformality dose distributions is currently proton therapy. It allows a significant reduction in radiation exposure to normal tissues compared to traditional photon beam radiotherapy methods. This can be achieved even when the target is close to critical body structures. The energy of the beams used in proton therapy is in the range of 50–300 MeV. This range of proton energies corresponds to a Bragg peak depth of ~3–30 cm and is determined by the possible depth of the tumour in the patient's body. Traditionally, analytical calculations of the dose rate neglect the contribution of nuclear reactions on the accelerated protons. However, the interaction of protons of such energies with light nuclei in biological tissue produces a large number of radionuclides that decay by emitting positrons. According to some estimates, they can increase a patient's dose by more than 20% [1].
We have investigated the activity yields of ^{34m}Cl ($T_{1/2}$=32 min) and ^{38}K ($T_{1/2}$=7.6 min) when irradiating natural calcium targets with accelerated protons of energies of 100 and 200 MeV. The irradiation was performed at the Prometheus proton therapy complex of the Physical-Technical Center, Lebedev Physical Institute of the Russian Academy of Science. The irradiated targets were measured using Ortec® and Canberra® semiconductor spectrometers with ultrapure germanium detectors having an energy resolution of 1.8–2.0 keV for 1333 keV ^{60}Co gamma radiation. The detection efficiency of the spectrometers was determined using standard calibration sources ^{152}Eu, ^{226}Ra, ^{137}Cs.
The gamma transitions accompanying the decay of ^{34m}Cl and ^{38}K were reliably determined in the measured gamma spectra. For 100 MeV protons, the cross sections of these processes were found to be σ(^{nat}Ca(p, XpYn)^{34m}Cl)=6.5±0.6 mbn, σ(^{nat}Ca(p, 2p1n)^{38}K)=9.3±1.0 mbn. For protons with energies of 200 MeV, the activity ratios of ^{34m}Cl and ^{38}K were found to be similar within the measurement error.
The activity yields of ^{34m}Cl were (3.1±0.2)10^{-8} Bq/proton for 100 MeV and (3.2±0.2)10^{-8} Bq/proton for 200 MeV. The results are discussed.

Section

Applications of nuclear methods in science, technology, medicine and radioecology

Primary author: Dr ZHELTONOZHSKAYA, Marina (Lomonosov Moscow State University)

Co-authors: Mr ADONYEV, Stepan (Lomonosov Moscow State University); Mr OVSYANNIKOV, Alexandr (Lomonosov Moscow State University); Mr SHEMYAKOV, Alexandr (P.N. Lebedev Institute of Physics, Russian Academy of Sciences, Physical-Technical Centre, Protvino, Russia)

Presenter: Mr ADONYEV, Stepan (Lomonosov Moscow State University)

Session Classification: Applications of nuclear methods in science, technology, medicine and radioecology