Contribution ID: **76** Type: **Poster report**

Photonuclear production of 18F, 99Mo, 149Pm, 153Sm and 175Yb by use of nanoparticles

Tuesday, 13 October 2020 19:15 (20 minutes)

Photonuclear technologies for the production of 18F, 99Mo, 149Pm, 153Sm and 175Yb with high specific activity were developed at the linear electron accelerator NSC KIPT. The method of recoil nuclei using oxides of nanoparticles of these elements to obtain isotopes of the lanthanide group and 99Mo was applied. Nanoparticles of CaF2 were used for obtaining 18F.

The proposed photonuclear technologies for the production of isotopes are alternative to the technologies widely used in the world at reactors and cyclotrons. The advantages of these technologies there are high specific activity, high isotopic purity (absence of other isotopes in the form of impurities), and no need to immobilize the resulting radioactive waste. Therefore these photonuclear technologies have no alternative.

Samples in the form of nanoparticles were activated by bremsstrahlung radiation on a linear accelerator with an electron energy of 13 MeV. Activated nanoparticles were used as donors in the reaction of recoil nuclei, and nanoparticles of biocompatible aluminosilicate - as an acceptor. The activity of the isotopes was measured by the Ge(Li)-detector. The ratio of recoil nuclei in aluminosilicate nanoparticles for 99Mo, 149Pm, 153Sm and 175Yb and sodium chloride for 18F ranged from 12.3% to 1.7%.

Also, preclinical studies have been conducted on the accumulation of the 99mTc isotope in blood plasma, isolated tumor cells, and also with the help of various carriers, the functional ability of individual organs of animals on a gamma camera has been registered.

The isotope production with use MoO3 nanoparticles with size 15 nm and of bremsstrahlung with Emax=25 MeV on 10 kW electron accelerator will allow producing 22 mCi/g per day of 99Mo with a high specific activity, which is necessary for manufacturing generators 99mTc-99Mo. For the production of 149Pm, 153Sm and 175Yb with E=25 MeV and a current 260 ⊠A it is possible to produce 0.5 Ci during the day by using of targets (30 g) of natural isotope composition. The estimation of the 18F production on an electron accelerator with a power of 10 kW and an energy of 25 MeV can be up to 1 Ci for 4 hours.

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Session Classification: Poster session 6

Track Classification: Section 8. Nuclear medicine.