Current projects and recent results

6. New developments at IRIS laboratory:

- **RIC-80 Project (Radioactive Isotopes on Cyclotron C-80) project.**

Recently, the cyclotron C-80 (beam energy 40-80 MeV and intensity up to 200 microA) is going to be put into operation at PNPI NRC KI. This cyclotron is intended for treatment of ophthalmologic diseases by irradiations of a malignant eye formation, as well as for production of a wide spectrum of medical radionuclides for diagnostics and therapy. The radioisotope installation RIC-80 (Radioactive Isotopes on Cyclotron C-80) facility will be installed at C-80. The parameters of the C-80 cyclotron allow to produce the broad nomenclature for radioisotopes, which are at present under discussion in corresponding publications as very perspective for diagnostics and therapy. The RIC-80 project consists of: three target stations; automatic transportation system to deliver the irradiated targets to "hot" cells for the radioisotope extraction and radiopharmaceutical preparation. One of the stations will be equipped with a mass-separator. It will allow to get separated some radionuclides of a high purity, which are implanted into a corresponding collector and from which they can be easily extracted. RIC-80 facility can provide the production of a range of medical radionuclides for diagnostics and therapy which are not accessible for the other facilities in Russia [1]. The essential components of accelerator facilities for medical isotope production are the target materials and the target devices, - a determinant of a production spectrum of medical radionuclides, a production efficiency and purity. This is a reason why the new target device development and investigation is the key factor for successful isotope production at RIC-80. In fig.1 the layout of the RIC-80 radio isotope complex constructed in the cellar of the experimental hall of the synchrocyclotron is shown. The unique parameters of the RIC-80 will allow for the production of a broad range of radioisotopes. Among these includes are ^{68}Ge, ^{82}Sr, ^{111}In, ^{123,124}I, ^{223,224}Ra and nuclides which are at present under discussion as perspectives for diagnostics and therapy: ^{64}Cu, ^{67}Cu, ^{67}Ga, ^{77}Br и ^{81}Rb.

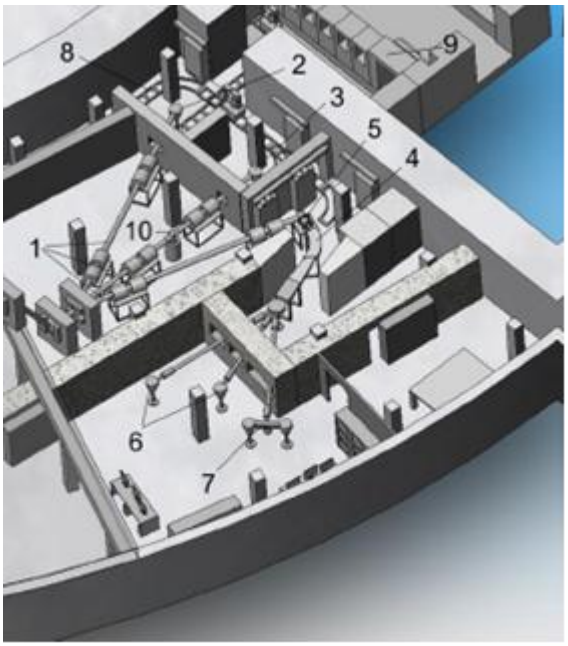

Fig. 1. Layout of RIC-80 radioisotope complex. 1 – proton beam lines to target stations (cellar), 2 – target station for radiochemical extraction of produced isotopes, 3 – target station for dry (high temperature heating) extraction of produced isotopes, 4 – mass-separator for production of medical isotopes samples of a high purity, 5 – target station of mass-separator, 6 – collecting stations for separated radio- nuclides, 7 – detector stations for obtained radionuclide purity measurement, 8 –

transportation system for activated targets moving to special storage places or to hot cells, 9 – storage place for irradiated targets, 10 – pneumatic rabbit station.

Pills of yttrium carbide were used as the target material for the first experimental tests for the production of ^{82}Sr. In fig. 2 gamma spectrum of collected radioactivity at the cooled collector during the heating of irradiated yttrium carbide sample is presented. The final efficiency of strontium extraction was about 90%. It has been established that radio nuclides decaying by alpha particle emission can be a very effective tool for the therapy of different malignant tumors at a very early stage of their formation. Among alpha decaying radio nuclides which have been used for therapy, are isotopes ^{223}Ra and ^{224}Ra, which can be produced by proton irradiation of uranium or thorium targets. In fig. 3 the alpha spectrum of species evaporated at 2400°C from a UC target and collected on the cooled tantalum collector is shown. There is a possibility to increase the yields of Ra isotopes by more than order of magnitude, using the ThC target instead of UC one. This target material possesses good characteristics (melting point, boiling point) to be used as a target under a high temperature coupled with the mass-separator ion source of surface ionization.

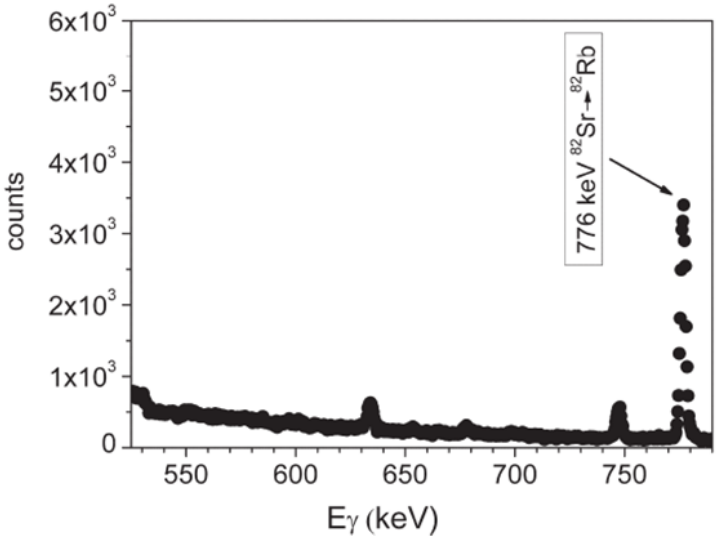

Fig. 2. Gamma spectrum of collected radioactivity at the cooled collector during the heating of irradiated yttrium carbide samples at a temperature interval 1950-2000°C.

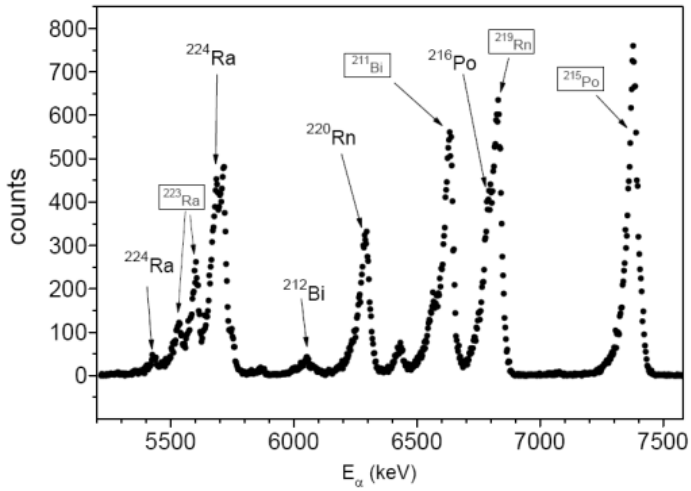

Fig. 3. The alpha spectrum of species evaporated at 2400°C from a UC target to the cooled tantalum collector. Isotopes from 223Ra decay chain are placed in boxes.

References

1. *Panteleev V.N., Barzakh A.E., Fedorov D.V.et al.* The radioisotope complex project "RIC-80" at the Petersburg Nuclear Physics Institute. Rev.Sci.Instrum. 86,123510 (2015).