Production of ^{124}I, ^{64}Cu and [^{11}C]CH_4 on an 18/9 MeV cyclotron

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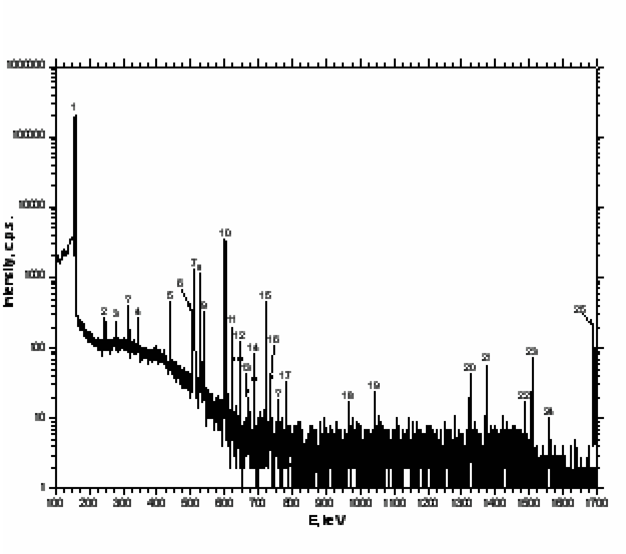
Iodine-124 ($T_{1/2}$ = 4.18 d) and copper-64 ($T_{1/2}$ = 12.7 h) are two very important radionuclides for radiopharmaceuticals production for preclinical research in a positron emission tomography (PET). The method for producing ^{124}I was based on a dry distillation of ^{124}I from a solid [^{124}Te]TeO_2 target technique. The platinum target disk was used as a base for TeO_2 melt and irradiated on COSTIS target station installed at the end of the external beam line of the IBA Cyclone 18/9 cyclotron. The target station was equipped with a 25 μm aluminum or 250 μm Nb window foil in front of the target, which results in a final beam energy of 17.7 or 13.5 MeV respective.

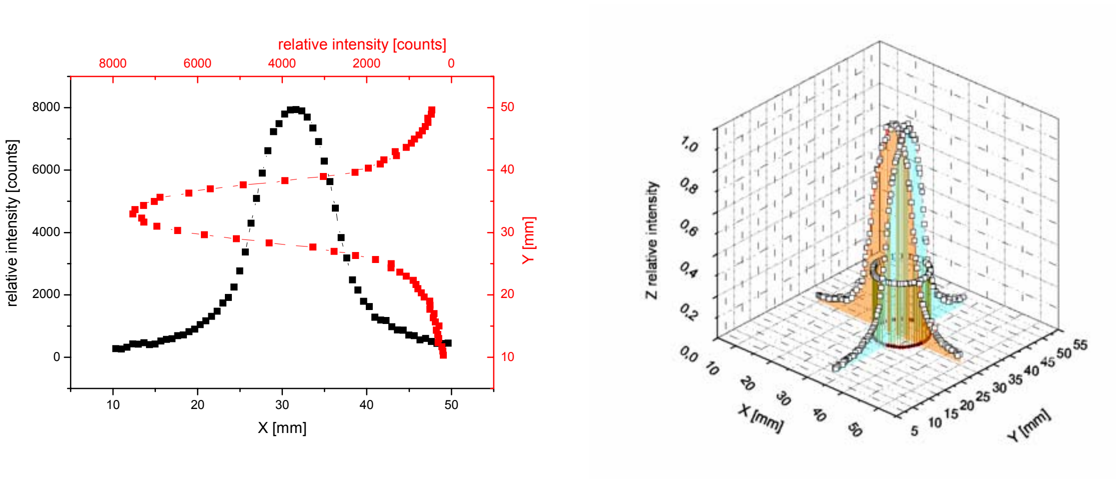


γ-spectra of the ^{124}I product at EOS

Peak	Nuclide	E, keV	Intensity, %	Peak	Nuclide	E, keV	Intensity, %
1	123I	158.97	83.3	14	123I	687.95	0.0267
2	123I	247.96	0.071	15	124I	722.78	10.35
3	123I	281.03	0.079	16	123I	735.78	0.062
4	123I	346.35	0.126	17	123I	783.59	0.059
5	123I	440.02	0.428	18	124I	968.22	0.435
6	123I	505.33	0.316	19	124I	1045.0	0.441
7	124I (annih.)	511.0	46.0	20	124I	1325.50	1.561
8	123I	528.96	1.39	21	124I	1376.0	1.75
9	123I	538.54	0.382	22	124I	1488.9	0.199
10	124I	602.72	62.9	23	124I	1509.49	3.13
11	123I	624.57	0.083	24	124I	1559.8	0.165
12	124I	645.82	0.988	25	124I	1691.02	10.88
13	124I	662.4	0.056				

γ-lines of the spectra with their energies and intensities

The ^{64}Ni(p,n)^{64}Cu reaction route was used for ^{64}Cu ($T_{1/2}$ = 12.7 h) preparation because its entrance channel is accessible at low energies and yield of the reaction is quite high. Disadvantage of the reaction used is high price of enriched ^{64}Ni. Gold and platinum targets were used for a thick ^{64}Ni target preparation by electro deposition. Because the external beam line of the cyclotron has no beam diagnostic devices, several aluminum plates were irradiated in the COSTIS target station with a 5 μA proton beam for 5 min with different settings for the beam focusing quadrupole magnets. After 15 minutes decay time the plates were scanned by a TLC scanner along the horizontal and vertical central axes of the plates in order to visualize the beam shape. The settings providing the most homogeneous beam spot on the target were selected and used further for the actual target irradiations. The radionuclidic purity of the product was determined by γ-spectrometry.



Beam profile measured on Al disk; Nb window 0.30 mm

Carbon-11 ($T_{1/2}$ = 20.39 min) was prepared in the form of methane in aluminum target made by IBA. Total irradiated volume of the gas mixture (90% N_2 +10%H_2) was 50 cm^3. Reaction used at irradiation was $^{14}N(p,\alpha)^{11}C$. Aluminum and niobium windows were used during irradiation. The irradiations were performed first without and then with niobium foil inside the target with purpose to eliminate the surface influence of aluminum. During the optimization of irradiation, different pressures of gas were tested as well as the beam currents. Produced methane was sorbed on Carboxen 1000 column at the temperature of -150 °C on TracerLab FX_C module made by GE Medical Systems.

Acknowledgement

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