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The Radiopharmaceuticals Production and Research Centre established by the Heavy Ion Laboratory of the University of Warsaw

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Abstract. The Radiopharmaceuticals Production and Research Centre was recently installed on the premises of the Heavy Ion Laboratory, University of Warsaw. Equipped with a medical PETtrace p/d cyclotron , radiochemistry synthesis and dispensing units and a modern quality control laboratory the Centre is intended to produce regularly for commercial purposes the classic PET radiopharmaceuticals (such -as e.g. FDG-). Situated on the largest Warsaw scientific campus OCHOTA, an important part of the Centre's activities will also be devoted to the production of known species for preclinical studies and research into innovative radiopharmaceuticals in collaboration with other scientific units of this Campus as well as with members of the Warsaw Consortium for PET Collaboration. Research into the accelerator production route of ^{99m}Tc will also begin shortly.

In 1994 the first heavy ion beam was extracted from the Warsaw Heavy Ion Cyclotron [1] and directed to a particle detector. This cyclotron was built by the Heavy Ion Laboratory (HIL) team in collaboration with the Dubna Centre and the Institute of Nuclear Research in Świerk, near Warsaw. During the next few years six cyclotron experimental stations were successively equipped and extensively used.

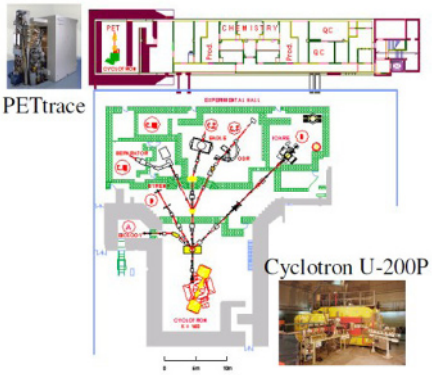

Figure 1. The layout of the University of Warsaw Heavy Ion Laboratory ground floor. The lower part of the figure shows the heavy ion cyclotron, its beam lines and six nuclear physics experimental stations. The Radiopharmaceuticals Production and Research Centre , (placed 6m underground) is presented in the upper part of the figure.

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At the beginning of this century, after more than six years of successful operation of the cyclotron a new direction in the development of the Warsaw Heavy Ion Laboratory was necessary in order to maintain its vitality and place in the forefront of the Polish research infrastructures. From a number of options discussed the installation of a new, commercial p/d cyclotron for the production of Positron Emission Tomography (PET) radioisotopes was selected.

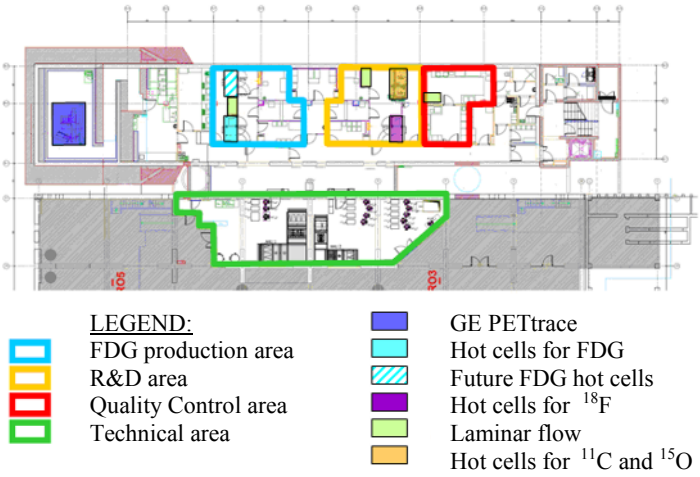


Figure 2. The layout of the Radiopharmaceuticals Production and Research Centre. The radioisotopes produced by the proton or deuteron beam from the PETtrace cyclotron (- left of the figure -) are transferred to one of the chemistry laboratories: L1 serving for the routine production of fluoro-deoxy-glucose (- FDG -) or L2 devoted to research activity with ^{11}C, ^{15}O or ^{18}F radioisotopes. The quality control area (- right of the figure -) is also divided into two parts : for testing regularly produced FDG and for radiopharmaceuticals in the research stage.

Figure 3. The 3D View of RPRC shown in Figure 2.

Supported by the Polish Ministry of Sciences, the International Atomic Energy Agency, the Ministry of Health, European Structural Funds and the University of Warsaw the Radiopharmaceuticals Production and Research Centre (RPRC) was established on the premises of HIL [2-5]. The Centre is equipped with a 16.5 MeV proton and 8.4 MeV deuteron GE PETtrace cyclotron, a number of hot cells, automatic synthesis and dispensing units and quality control equipment and is intended to produce commercial radiopharmaceuticals based on ^{18}F (Fluoro-deoxy-glucose, FDG) and research radiopharmaceuticals based on ^{18}F but also on ^{11}C and ^{15}O. For these aims the radiopharmaceutical production area consists in a separated, routine FDG production laboratory and the research laboratory. The close vicinity (about 600 m) of the Nuclear Medicine

Department of the Warsaw Medical University, equipped with a modern PET-CT scanner will facilitate the development of a diagnostics and research programme including even the shortest lived radioisotope ^{15}O after the installation of an underground capillary line (in preparation). The ^{15}O isotope is also required by an animal micro-PET, located close by in the new chemistry-biology research unit of the University of Warsaw. Similarly, the regular production of longer lived metallic radioisotopes will be possible after the installation of a well shielded external beam line on the cyclotron.

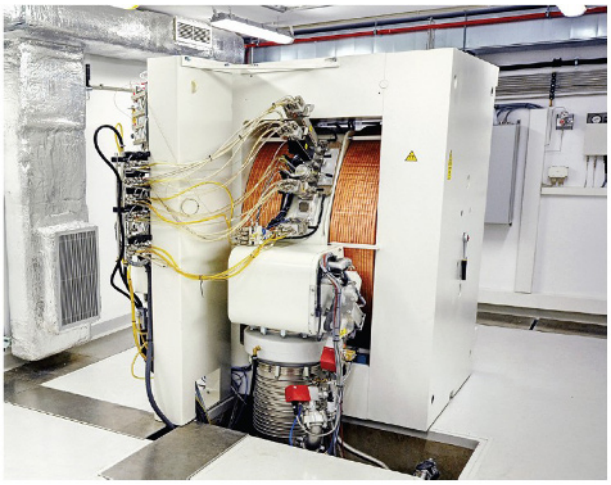


Figure 4. The PETtrace p/d cyclotron installed in its cave.

Besides the regular everyday production of the commercialized FDG radiopharmaceutical, synthesis of other known species is planned for preclinical research in collaboration with the Warsaw Consortium for PET Collaboration (see Fig. 6) or members of the Scientific Campus Ochota network. Another research area will be innovative radiopharmaceuticals for PET-CT or PET-NMR.

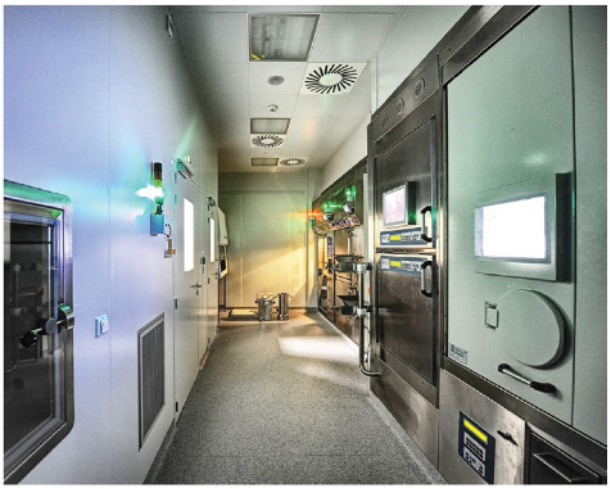
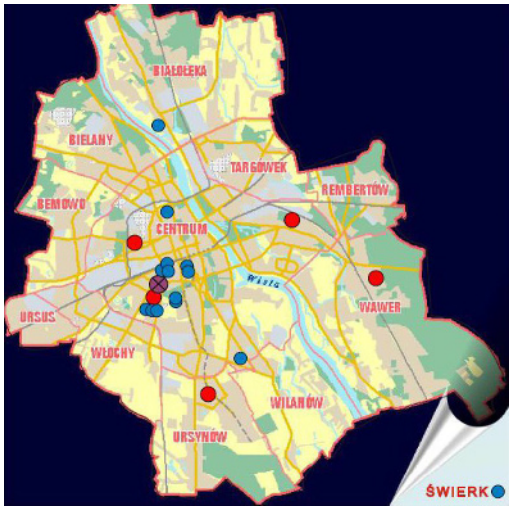


Figure 5. Hot cells in the research laboratory (photos Grzegorz Krzyżewski).



Radiopharmaceuticals Production Center – HIL

PET Diagnostics Centers

Research Units

1. Dep. of Nucl. Med., Clin. Hosp. Warsaw Med. Univ.
2. Department of Nuclear Medicine, Institute of Cardiology
3. Div. of Biomed. Eng., Warsaw University of Techn.
4. Division of Med. Electronics, Warsaw Univ. of Techn.
5. Faculty of Biology, University of Warsaw
6. Faculty of Chemistry, University of Warsaw
7. Faculty of Physics, University of Warsaw
8. Faculty of Psychology, University of Warsaw
9. Heavy Ion Laboratory, University of Warsaw
10. Insitute of Biochem. and Biophysics, Polish Ac. of Sci. .
11. Instisute of Nuclear Chemistry and Technics
12. Institute of Psychiatry and Neurology
13. Institute of Tuberculosis and Lung Diseases
14. Interdisciplinary Cent. of Math. and Computer Modeling
15. Military Medical Institute, Nuclear Medicine Center
16. M. Mossakowski Pol. Ac. of Sci. Exp. Medicine Center
17. M. Nencki Instit. of Exp. Biology, Pol. Ac. of Sci.
18. Nucl. and Med. Electronics Div. War. Univ. of Techn.
19. Oncology Center, Maria Sklodowska-Curie Institute
20. Radioisotope Centre - POLATOM

Figure 6. Warsaw Consortium for PET collaboration .

An important example of cyclotron beam use for non-PET radiopharmaceuticals will be research into an alternative (via accelerators) way of producing the most popular isotope in nuclear medicine, ^{99m}Tc, presently available from the nuclear reactor produced ^{99}Mo generators. To this end an external irradiation station for solid targets sustaining high proton current (-up to 80 μA-) is in the construction phase. The proton irradiated ^{100}Mo samples will be further investigated by the POLATOM Centre in Świerk and the Institute of Nuclear Chemistry and Technology in Warsaw, collaborating in this project. This activity is performed within the Coordinated Research Project of the International Atomic Energy Agency (IAEA) and is also supported by the Polish NCBiR research funding agency. The collaboration of A.Stolarz and B. Radomyski in this activity is appreciated.

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