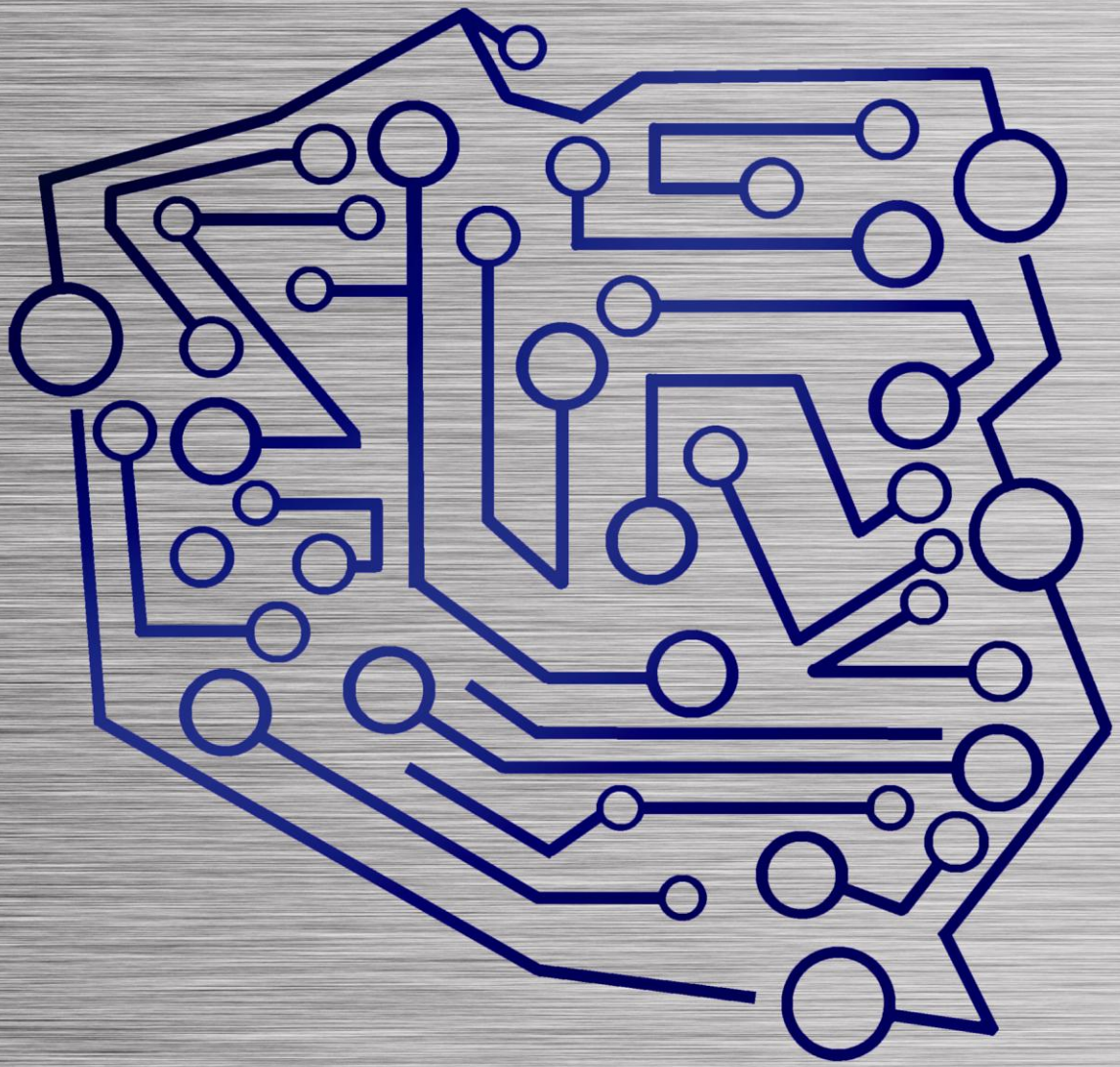
Ministry
of Foreign Affairs
Republic of Poland



Catalogue of technologies
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LIST OF INSTITUTES BY SECTOR

BUILDING AND ARCHITECTURE

ELECTROTECHNICS, ELECTRONICS, AUTOMATION AND INFORMATION TECHNOLOGIES

ENVIRONMENTAL PROTECTION AND ENGINEERING; ENVIRONMENTAL, AGRICULTURAL AND FOREST TECHNOLOGIES

HEALTH PROTECTION AND PHYSICAL CULTURE

MATERIAL AND CHEMICAL TECHNOLOGIES, MATERIAL SCIENCE, CHEMICAL AND PROCESS ENGINEERING

MECHANICS, BUILDING AND OPERATION OF MACHINES, PRODUCTION ENGINEERING

MEDICAL SCIENCE

MINING, TECHNICAL GEOLOGY, GEODESY, POWER ENGINEERING AND TRANSPORT

NON-CLINICAL RESEARCH UNITS

PHYSICS AND ASTRONOMY

SAFETY AND OTHER GENERAL TECHNICAL ASPECTS

SMALL RESEARCH UNITS IN TECHNICAL FIELDS

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PHYSICS AND ASTRONOMY

INSTITUTE OF PLASMA PHYSICS AND LASER MICROFUSION, *EURATOM* – ASSOCIATION

(Instytut Fizyki Plazmy i Laserowej Mikrosyntezy)

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The Institute of Plasma Physics and Laser Microfusion (IPPLM) was founded on the 1st January of 1976. Since June, 2001 it has carried its activities under the authority of the Ministry of Economy of the Republic of Poland while the research program has been under surveillance and co-financing of the Ministry of Science and Higher Education. The research carried out at the IPPLM includes studies of plasma physics and applications as well as scientific and technological efforts to investigate thermonuclear fusion, to provide a safe energy source for the future.

The IPPLM is an institution which is authorized by the Ministry of Science and Higher Education to coordinate the research on magnetic confinement fusion (MCF) in Poland under EURATOM Community nuclear fusion program on the basis of the Contract of EURATOM-IPPLM Association signed with EURATOM Community (represented by the European Commission). These works concern plasma physics and technology for MCF toroidal thermonuclear devices (tokamaks and stellarators).

Studies of laser fusion (an important method of development of inertial fusion energy - IFE) and laser plasma are carried out as a part of the European HiPER project, projects supported by LASERLAB-Europe Consortium and by EURATOM Community within IFE keep-in-touch activity to a limited extent.
The Institute employs about 80 persons including 6 professors and 20 doctors.
The structure of the IPPLM includes two research divisions: Division of Laser-Produced Plasma (DLPP), and Division of Plasma in Magnetic Field (DPMF). The DPMF of IPPLM includes the International Centre for Dense Magnetised Plasmas established in agreement with UNESCO. This laboratory is dedicated to science, education and technology transfer. Most of the IPPLM's activity is carried out within broad international cooperation, mainly supported by European projects.

The scope of activity of the IPPLM includes:

- study of physical processes in and technology of tokamaks and stellarators
- theoretical analysis and numerical simulations of magnetically confinement plasmas in tokamaks and stellarators
- study of plasma-wall interaction technologies with application of laser methods and visible spectrometry
- development and application of diagnostics of X-rays, VUV and visible radiation as well as neutrons emitted from plasmas in tokamaks and stellarator W-7X
- studies and applications of dense magnetized plasmas generated in Plasma Focus device PF 1000 as an intense pulsed source of X-rays and neutrons
- optimization of Hall plasma thrusters
- study of laser-produced plasma physics and technological applications
- study of processes related to inertial confinement fusion (laser fusion)
- study of laser-matter interaction physics at ultrahigh laser beam intensities
- study of hydrodynamic processes accompanying the laser-matter interactions
- development and applications of advanced diagnostics for laser-produced plasmas (ion and X-ray diagnostics, interferometry).

The Institute offers its expertise and know-how in above mentioned research areas, development of measuring methods and technologies. We are interested in developing scientific and R/D cooperation and executing common research projects in these areas.

In IPPLM there were elaborated and implemented into research practice and technology, among others:

- technology of small Plasma Focus devices as a pulsed sources of X-ray radiation and neutrons
- various ion and neutron diagnostics for hot and dense plasmas (laser-produced plasmas, plasmas generated in Z-pinch and Plasma Focus discharges)
- multi-frame laser interferometry for measuring of pulse plasma dynamics
- laser-induced material technology (including a removal of surface layers, ion implantation for modification of semiconductor materials)
- advanced Hall thrusters for space technology
- visible (including Laser-Induced Breakdown Spectrometry – LIBS), VUV and X-ray spectroscopy (including gas electron multiplier detectors (GEM), pulse height analysis (PHA) and multi-foil spectroscopy (MFS) systems.

Most of above mentioned methods, equipment and diagnostic systems can be easily adapted for non- plasma applications. The IPPLM's offer includes: research projects, technology projects concerning devices, measuring equipment, cooperation and consultancy regarding those projects, support in delivery of equipment as well as personnel training.

NATIONAL CENTRE FOR NUCLEAR RESEARCH

(Narodowe Centrum Badań Jądrowych)

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Radioisotope Centre POLATOM carries out research programs related to the application of radioactive preparations and radiolabelled compounds in various fields in medicine, research and industry. Main areas of research activity of Radioisotope Centre POLATOM present multidisciplinary character and combine chemistry and physics of radionuclides, radiochemistry, analytical chemistry, metrology of ionizing radiation, biology, pharmacy and nuclear medicine.

The main research and development domains are:

- Investigation of novel biomolecules as carrier for radionuclides and preliminary assessment of their diagnostic and/or therapeutic utility
- Development of technologies for production of high specific activity radionuclides in nuclear reactors and accelerators, using highly enriched target materials and modern separation techniques
- Development of methods for radioactivity measurement and assessment of radionuclidic purity (determination of α, β, and γ impurities)
- Chemical and pharmaceutical development and biological activity assessment using in vitro and in vivo methods of new radiopharmaceuticals for clinical application.

Based on the research programs POLATOM offers technologies for manufacturing of radiochemicals and sealed radiation sources for various application, radiopharmaceuticals and related services. POLATOM offers also neutron irradiation services in the Maria Research Reactor.

Among various services related to the radiation protection POLATOM offers design and manufacturing of biological shielding against α, β and γ radiation and shielding for specialized devices for the pharmaceutical and nuclear industry.

Laboratory of Radioactivity Standards in the Radioisotope Centre POLATOM in Otwock, Poland, is the only laboratory in Poland performing radioactivity measurements of α-, β- and γ-emitters by absolute methods and performing calibration of standard solutions and radioactive sources.

President of the Central Office of Measures in Poland (GUM) in 1999 established and with Decision No. 1/2004 of 21 April 2004 confirmed the establishment of the National Standard of Radionuclides Activity in Poland. The standard is stored and used in the Laboratory of Radioactivity Standards. It consists of triple-to-double coincidence ratio (TDCR) system, 4π(LS)-γ coincidence/anticoincidence system and X-γ coincidence system. These are unique measuring systems of the highest metrological quality in Poland, which are used for the absolute methods of radioactivity measurements. LRS transmit the unit of radioactivity to users of radioactive sources, providing them with standard solutions and sources, and performing the calibration of dose calibrators. LRS also participates in international key comparisons of radioactivity measurements, enabling the linking to the global system of national standards. These comparisons are organized by the International Bureau of Weights and Measures BIPM and the European Association of National Metrology Institutes EURAMET. The laboratory also participates in comparisons within the framework of the International Reference System SIR.

Other systems available at LRS, such as liquid scintillation counter TriCarb 2910 TR, liquid scintillation counter Wallac 1411, set of four scintillation counters with NaI(Tl) detectors, set of three 4π ionization chambers, dose calibrator Capintec CRC-15β and three spectrometric systems with HPGe detectors can be used for determination of radionuclides radioactivity as secondary systems related to the National Standard in an unbroken chain of comparisons. LRS is also equipped in 2π and 4π gas proportional counters adequate to determining particle flux leaving the area of the source and the dose rate meter MAD 2000 for assessment of absorbed dose.

Laboratory of Radioactivity Standards offers activity standards in the form of solutions and solid sources:

- Solutions of individual radionuclides
- Mixed solutions – intended to serve as calibration solutions for systems used to measure aqueous samples of low activity
- Point sources of individual radionuclides – intended for the calibration of □, □ or photon spectrometers
- Point sources from a mixture of various radionuclides
- Check sources – intended for the control of dose calibrators used in nuclear medicine departments
- Volume sources from a mixture of various radionuclides – intended for the calibration of systems used to measure environmental samples

The LRS has implemented and maintained quality management system compliant with the international standard ISO / IEC 17025:2005. As a calibration laboratory it is accredited by Polish Centre for Accreditation, a signatory to EA MLA and ILAC MRA that include recognition of calibration certificates.

AP 120

Laboratory of Radioactivity Standards as accredited calibration laboratory (accreditation no. AP 120) offers following services:

- Calibration of dose calibrators with ionization chambers
- Calibration of radioactive solutions with primary and secondary methods
- Calibration of radioactive point sources of γ-emitters
- Calibration of radioactive control sources for use with dose calibrators
- Calibration of radioactive area sources

Outside accreditation scope LRS offers following services:

- Calibration of radioactive multigamma solutions and sources
- Analysis of radionuclidic composition and determination of radionuclides activity in different materials
- Dose rate measurements for ophthalmic applicators

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Department of Nuclear Equipment HITEC NCBJ

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HITEC is a manufacturing department of the Polish state owned research and development laboratory: National Centre for Nuclear Research (in Polish – Narodowe Centrum Badan Jadrowych). The Centre, being one of the largest scientific institutes in Poland, carries out pure and applied research on subatomic physics, i.e. the elementary particle and nuclear physics, reactor physics, hot plasma physics, material engineering and related fields. The Centre is localized in Otwock, the satellite city of the country capital, Warsaw. The 44 ha campus houses numerous research facilities, most notably the research nuclear reactor MARIA. The reactor is used not only for scientific purposes but in equal manner for production of radiopharmaceuticals. The Centre employs over 1000 employees, among whom almost 200 are professors or Ph.D. degree holders.

HITEC (also known under its Polish name Zaklad Aparatury Jadrowej) benefits out of the research capabilities and experience of the parent Centre and puts scientific ideas for practical use. HITEC specializes in the applications of accelerator technologies in medicine and industrial radiography. For over 40 years the company has been designing, manufacturing and marketing a range of medical and industrial electron accelerators along with complementary equipment and software.

HITEC is headquartered in Otwock, at the main campus of National Centre for Nuclear Research. Over 90 employees of HITEC collaborates closely with the research part of the Centre on improving current products and developing the new ones.

HITEC line of medical accelerators consists of three devices intended for carrying out cancer radiotherapy:

Coline 10 - medical accelerator provides photon and electron beams irradiation with energy from 6 up to 10 MeV. In addition to solid therapeutic parameters, Coline 10 distinguishes itself with a minimal footprint which allows for its installation in the environment frequently not available for other manufacturers.

Coline 6 – is a state of the art medical accelerator with 6 MeV photon beam, fully capable of delivering modern treatment techniques, IMRT and IGRT. For that purpose, Coline 6 can be equipped with a custom Multileaf Collimator and an Electronic Portal Imaging Device.

Coline 4 - medical accelerator provides 4 MeV photon beam. Coline 4 has been designed as an inexpensive replacement for cobalt units. The International Atomic Energy Agency advocates gradual decommissioning of cobalt units for therapeutic and safety reasons. Coline 4, having the same small footprint as Coline 10, allows its users to benefit from all the advantages of the accelerator technique while keeping the costs under control.

The other HITEC products intended for use in the area of medicine are the following:

Simax - radiotherapy simulator used in the preparation for the actual irradiation. Accurate treatment simulation is vital for the success of radiotherapy and Simax is equipped with all the elements that allow it.

Polkam 16 - treatment table, designed for precise patient positioning during the irradiation process or simulations. Polkam 16 is also manufactured in a Mould Room version, specialized for the patient preparation for radiotherapy.

Polkam TBI – a unique treatment table solution designed for patient positioning and fixation during total body irradiation in preparation for a bone marrow transplantation.

HITEC industrial products are centered around two linear accelerator models designed for non-destructive examination using radiographic method:

Lillyput 3 - linear accelerator provides 7 and 9 MeV photon beams. Lillyput 3 is offered in both stationary and mobile configuration.

Lillyput 4S – linear accelerator provides 4 and 2 MeV photon beams. Extremely compact design and excellent beam parameters make it an ideal entry-level radiographic linac.

Both models of HITEC industrial accelerators can be supplemented by additional accessories: imaging devices and manipulators.

HITEC also designs and manufactures custom-built linear accelerators.

For both medical and radiographic application, HITEC manufactures

X-Ray shielding doors – manufactured according to the highest standards for protection against ionization radiation of energy up to 25 MeV.

HITEC manufactures various components or instruments for scientific applications in the area of **accelerator physics**, either electron or proton, for leading European high energy physics laboratories.

HITEC manufacturing process has been ISO 9001 certified. All HITEC products carry the **CE mark.**