



Nuclear Centre at Swierk
30 km from Warsaw
44 ha area



Institute	site	staff	supervised	funded
National Centre for Nuclear Research (NCBJ)	Świerk, Łódź, Warsaw	1114	Ministry of Economy	Ministry of Science & Higher Education
Institute of Nuclear Chemistry & Technology (ICHTJ)	Warsaw	241	Ministry of Economy	Ministry of Science & Higher Education
Central Laboratory for Radiological Protection (CLOR)	Warsaw	53	Ministry of Economy	Ministry of Science & Higher Education
Institute of Nuclear Physics (IFJ) Polish Academy of Sciences	Cracow	486	Ministry of Science & Higher Education	Ministry of Science & Higher Education

Universities with some nuclear research and education:

AGH Technical University in Cracow,
 Warsaw University of Technology, University of Warsaw,
 Technical University in Gdańsk, Silesian University of Technology,
 Wrocław Technical University, + ...

Institute of Nuclear Research IJ - was established (initially in the structure of Polish Academy of Science) in June 1955 by the decision of Polish government - 60 years ago.

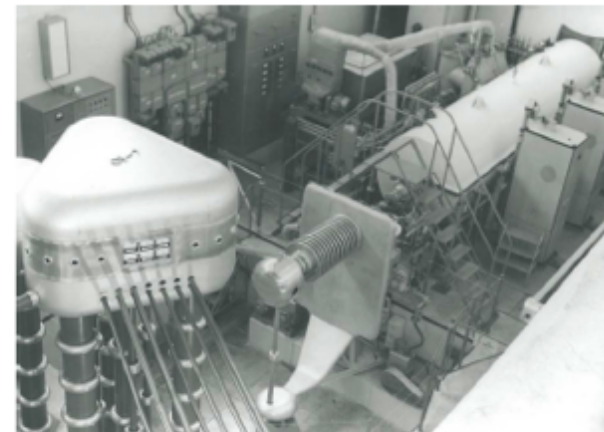
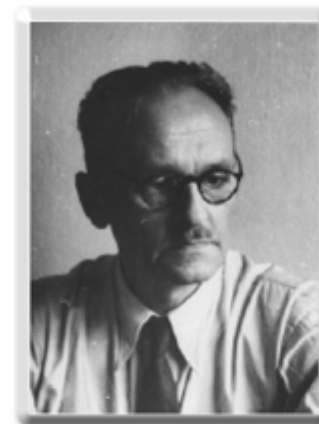
Accelerators

Prof. Andrzej Soltan already in 1938 developed the first in Poland accelerator of hydrogen and deuterium ions to an energy of around 300 keV.

Prof. Andrzej Soltan nominated in 1955 to the position of the general director of IJ, continued his research in this area in order to establish the necessary instrumental basis for nuclear physics investigations.

New idea of resonance accelerating structure developed in the 50s by L. Alvarez was implemented by A. Soltan and the IJ team into a project carried out 1956-1970.

10 MeV Proton Linear Accelerator was named „Andrzej” to honour Prof. Soltan.



General view of proton linear accelerator „Andrzej”

Institute of Nuclear Research IJB - was established (initially in the structure of Polish Academy of Science) in June 1955 by the decision of Polish government - 60 years ago.

Nuclear Research Reactor EWA

1989 issued by
Polish National Bank



- Institute joins basic and applied research

in the following domains:

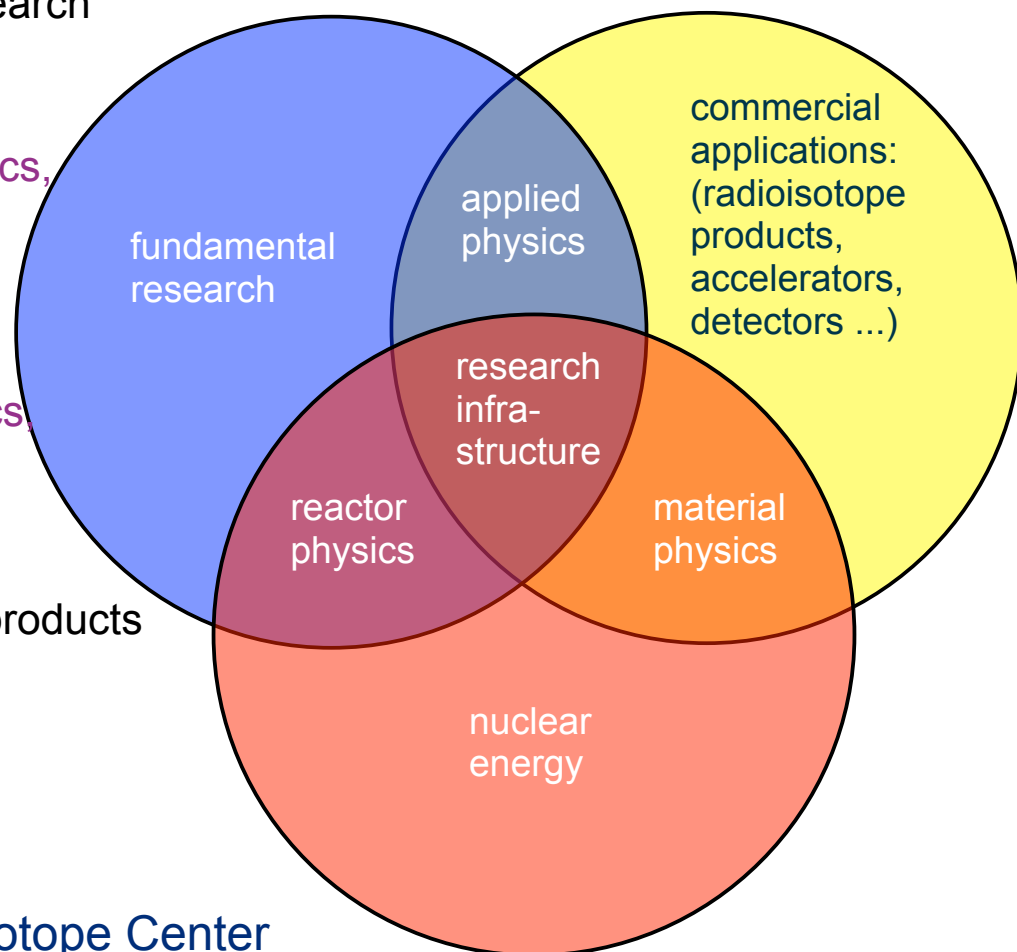
- particle physics, nuclear physics,
- astrophysics, plasma physics,
- material physics,
- reactor and accelerator physics,
- nuclear energy

- medical accelerators, radioisotope products



Radioisotope Center

export to 78 countries,
 ^{99}Mo - 18% of world production



Department of Nuclear Systems Operation

MARIA Reactor

Material Physics Department

Material Research Laboratory

Department of Fundamental Research

Department of Nuclear Techniques and Equipment

Division of Nuclear Equipment HITEC

Complexity Center

Computing Center Świerk

The largest research institute in Poland
1114 employees,
inc. 60 prof. & 122 PhD

Scientific achievements:

~600 reviewed papers,
~10000 quotations each year

Hirsh index = 125,

5th position in Poland

SCImago „Normalized Impact”:

1st in Poland,

8th in region,

158th in the world

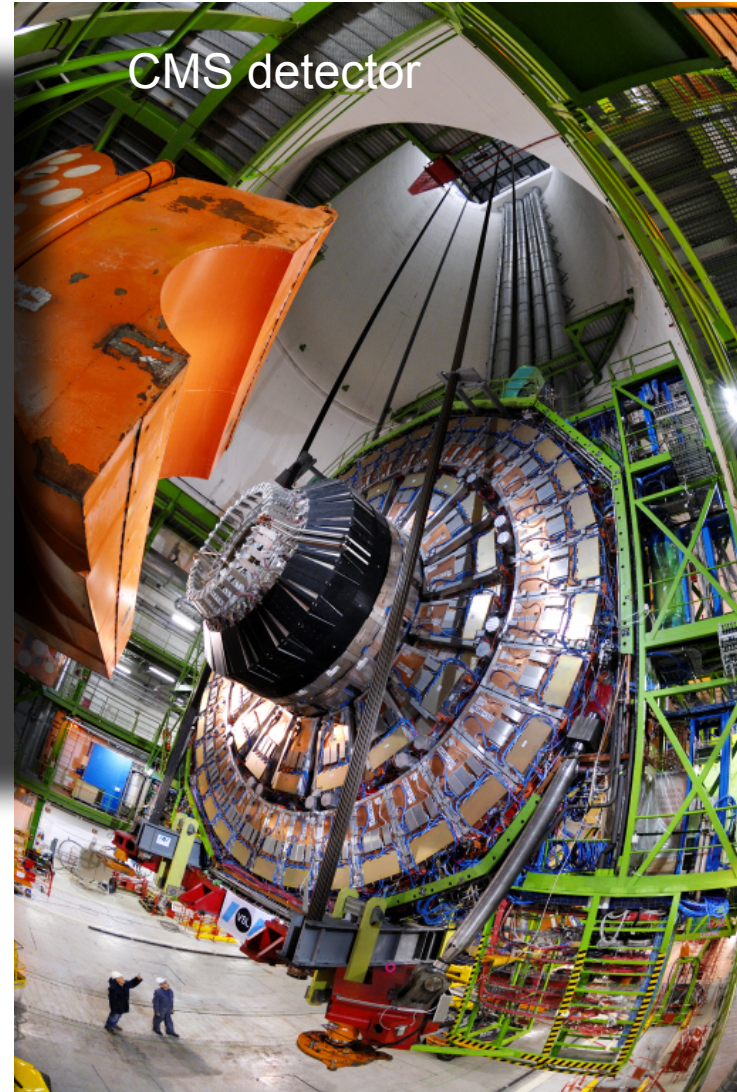
International collaborations with largest laboratories in the world (CERN, DESY, Grenoble, JParc, FAIR, Julich, ESS, JINR, etc), cooperation in many universities around the world

Radioisotope Centre
POLATOM-NCBJ

LHC accelerator



CMS detector



Our contribution:

- CMS muon trigger electronics
- LHCb „straw tube” chambers
- Linac4 accelerating structures

Domains:

- nuclear physics
- particle physics
- neutrino physics
- astroparticle physics
- plasma physics

Projects:

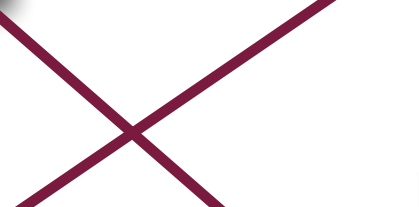
- FAIR
- LHC, ILC
- T2K, LAGUNA
- π of the Sky, POLAR, GRIPS
- ITER, W7-X
- FLASH, XFEL

Technologies:

- nuclear
- accelerator
- detector
- material
- informatics

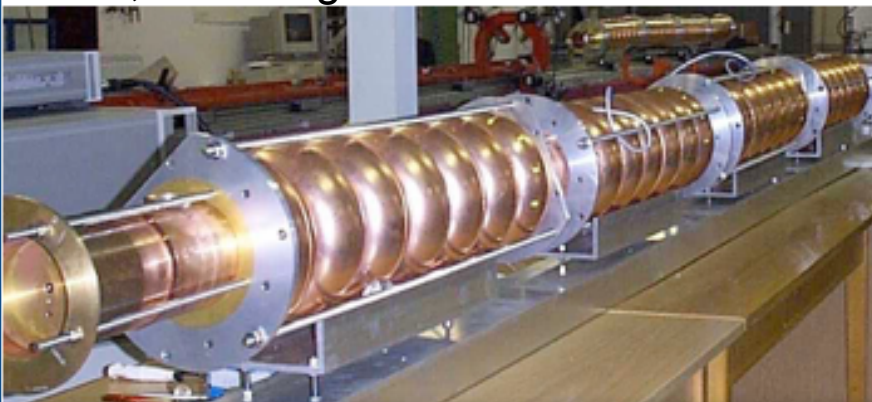
Applications:

- energy
- industry
- medicine
- environment
- homeland security
- art history



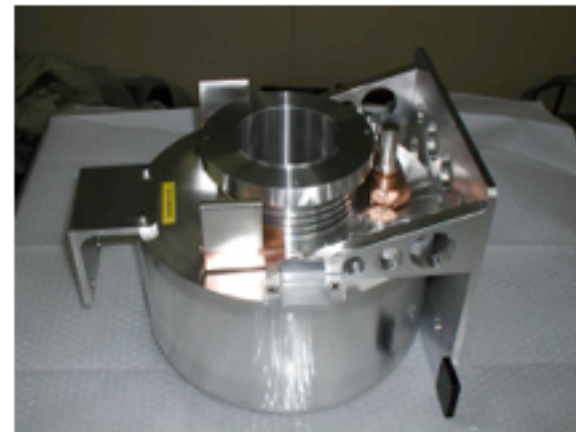
Name site	Const- ruction	Cost	Contribution		
			Poland	NCBJ	
European-XFEL DESY Hamburg	2010- 2016	1,2 G€	27 M€	6 M€	accelerator components
Linac4 dla LHC CERN Geneve	2008- 2014		-	1 M€	p-buncher, π -mode structures PIMS
Stellarator W7-X Greifswald	2011- 2014	0,4 G€	6 M€	4,5 M€	neutral beam injection components
FAIR Darmstadt	2012- 2017	4,4 G€	24 M€	~1 M€	detector components
European Spallation Source (ESS) Lund	2008- 2025	1,5 G€	30 M€	16 M€ ?	accelerator components, radiation calculation, ...
Jules Horowitz Reactor (JHR) Cadarache	2012- 2019	1,0 G€	10 M€?	5 M€?	hot cell to measure gas composition
Experiment GBAR CERN Geneve	2012- 2016		-	~1,2 M€	e ⁻ accelerator construction

Prototype cavities 1.3 GHz for Tesla-FEL
DESY, Hamburg



From research instruments to
commercial applications

Target for experimental facility



Isolde, CERN, Geneva

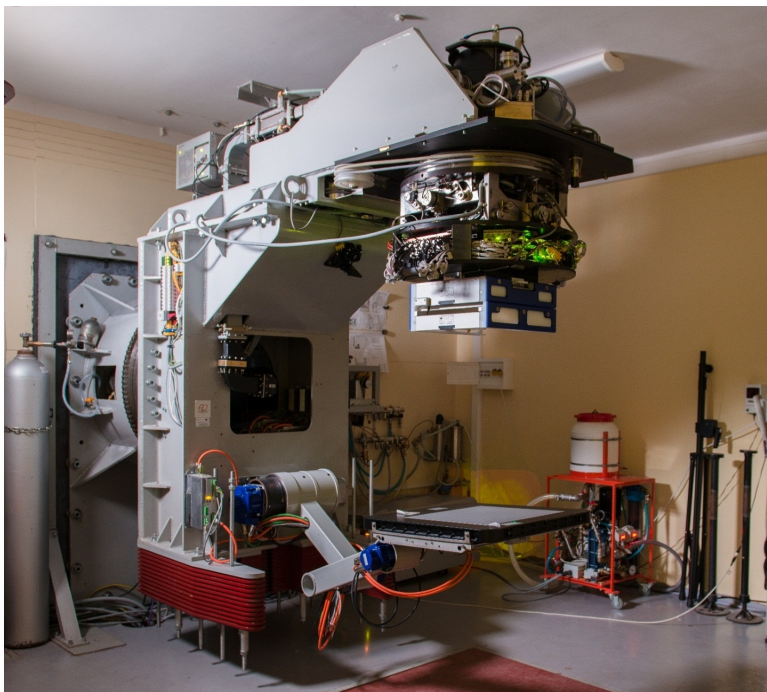


Accelerator „Lillyput” for industrial radiography



Accelerator for
radiotherapy

COLINE



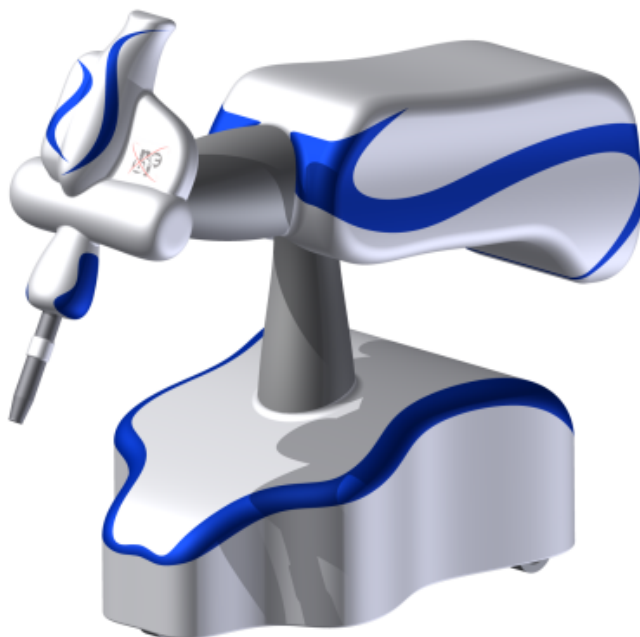
Coline 6 - photons 6 MeV



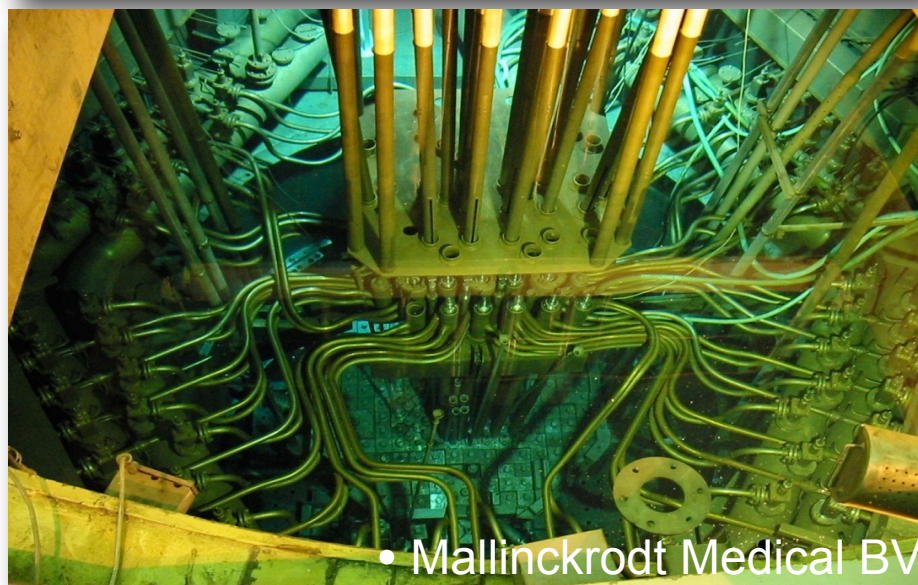
cooperation with UJP Hitec Systems S.A.

INTRALINE - accelerator for radiotherapy for surgical operations

electrons 4-12 MeV



System RTG for large size scan - CANIS
border protection etc.

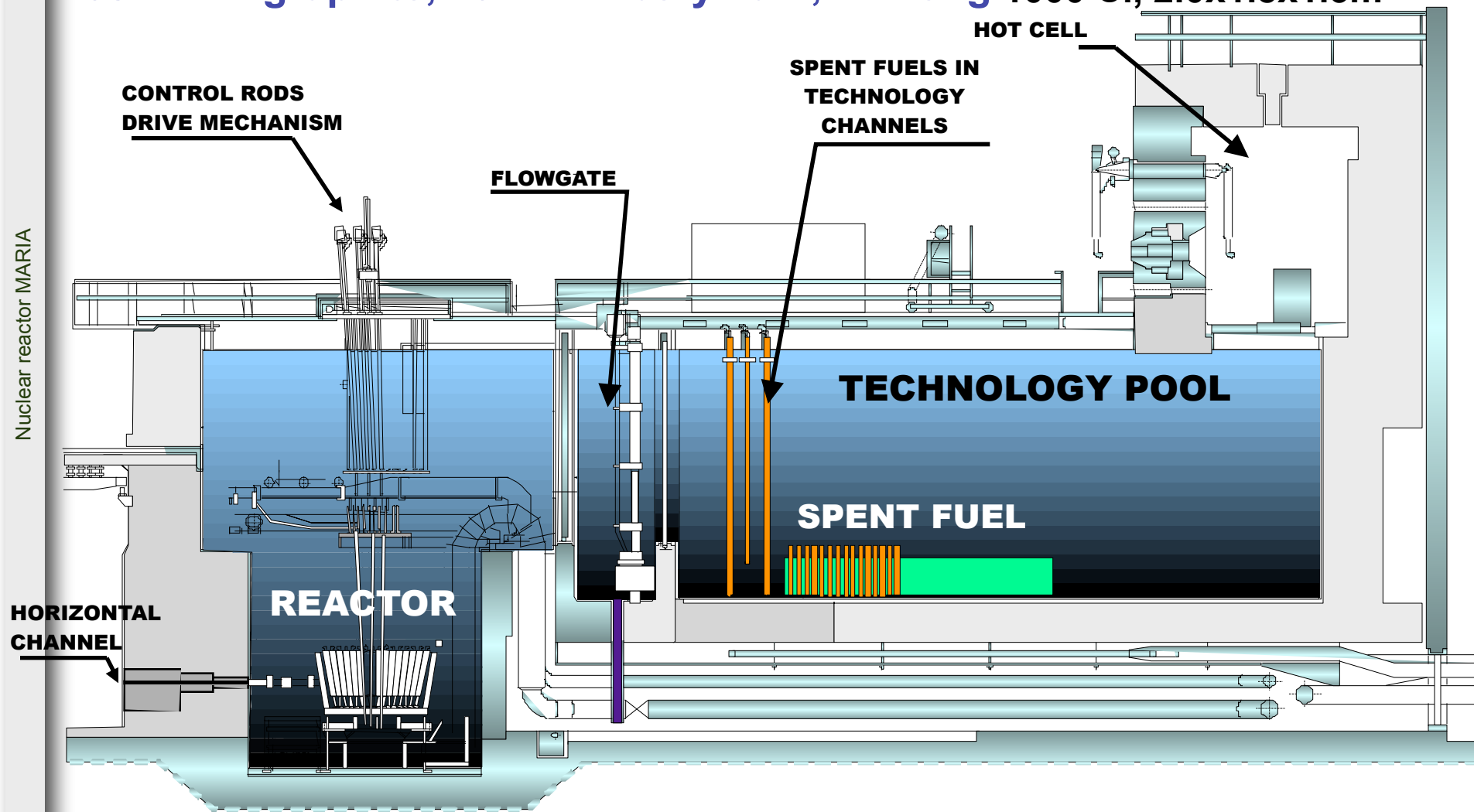


- built 1974, upgrade 1992
- pool type
- H₂O, Be moderated
- 30 MW thermal power
- neutron flux:
 - thermal $4 \cdot 10^{14}$ n/cm²s
 - fast $2 \cdot 10^{14}$ n/cm²s
- neutron beam research, material irradiation, radioisotope production
- ⁹⁹Mo for medical use
18% of world production
- 1 week of Maria irradiation = 100 000 medical procedures

• Mallinckrodt Medical BV POLATOM-NCBJ

Each channel is individually connected to the primary cooling circuit

Irradiation channels: $\varnothing=79\text{mm}$ in fuel channels, 38mm in graphite, 23mm in beryllium, 1m long 1000 Ci, 2.0x1.8x1.3m



PRODUCTS FOR NUCLEAR MEDICINE

Radiopharmaceuticals for diagnostic and therapy

- MIBG – ^{131}I for diagnostic use
- MIBG – ^{131}I for therapeutic use
- MIBG – ^{123}I for injection
- Sodium iodide, $^{\text{Na}}^{131}\text{I}$ for injection
- Sodium iodide, $^{\text{Na}}^{131}\text{I}$ capsules for diagnostics
- Sodium iodide, $^{\text{Na}}^{131}\text{I}$ capsules for therapy
- Sodium orthophosphate, $\text{Na}_2\text{H}^{32}\text{PO}_4$ for injection
- Hipuran – ^{131}I for injection
- Strontium chloride, $^{89}\text{SrCl}_2$

Kits for labelling with $^{99\text{m}}\text{Tc}$

- PoltechColloid, 0,17 mg
- PoltechDMSA, 1 mg
- PoltechDTPA, 13,25 mg
- PoltechMBrIDA, 20 mg
- PoltechMDP, 5 mg
- PoltechMIBI, 1 mg
- PoltechRBC, 14,40 mg
- $^{99\text{m}}\text{Tc}$ -Tektrotyd

Radiochemicals (pharmaceutical grade)

- Sodium chromate, $\text{Na}_2^{51}\text{CrO}_4$ for injection
- $^{64}\text{CuCl}_2$ as cupric (II) chloride
- ^{59}Fe as Iron (III) citrate, $\text{FeC}_6\text{H}_5\text{O}_7$
- ^{51}Cr as ^{51}Cr -EDTA for injection

Precursors for labelling

- LutaPol
- ItraPol

Radionuclide generators

- $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator
- $^{188}\text{W}/^{188}\text{Re}$ generator

Accessories for Nuclear Medicine Department



PRODUCTS FOR RESEARCH AND DEVELOPMENT

Radiochemicals reagents

Antimony ^{124}Sb
 Arsenic ^{76}As
 Barium ^{131}Ba
 Barium ^{133}Ba
 Bromine ^{82}Br
 Cadmium ^{109}Cd
 Cadmium $^{115\text{m}}\text{Cd}$
 Caesium ^{131}Cs
 Caesium ^{134}Cs
 Caesium ^{137}Cs
 Calcium ^{45}Ca
 Chromium ^{51}Cr
 Cobalt ^{58}Co
 Cobalt ^{60}Co
 Copper ^{64}Cu
 Europium ^{152}Eu
 Europium $^{152+154}\text{Eu}$
 Gold ^{198}Au
 Holmium ^{166}Ho
 Iodine ^{131}I

Indium $^{114\text{m}}\text{In}$
 Iridium ^{192}Ir
 Iron ^{55}Fe
 Iron ^{59}Fe
 Lanthanum ^{140}La
 Lutetium ^{177}Lu
 Neodymium ^{147}Nd
 Phosphorus ^{32}P
 Rhenium ^{186}Re
 Rubidium ^{86}Rb
 Samarium ^{153}Sm
 Scandium ^{46}Sc
 Selenium ^{75}Se
 Silver $^{110\text{m}}\text{Ag}$
 Sodium ^{24}Na
 Strontium ^{85}Sr
 Strontium ^{89}Sr
 Strontium ^{90}Sr
 Sulphur ^{35}S
 Terbium ^{160}Tb
 Thallium ^{204}Tl
 Thulium ^{170}Tm
 Tin ^{113}Sn

I-131 hot cells

Y-90 & Lu-177
hot cells



Radiopharmaceuticals with
manufacturing authorisation

Quality Assurance System
certified:

PN-ISO 9001 :2001
GMP and GLP

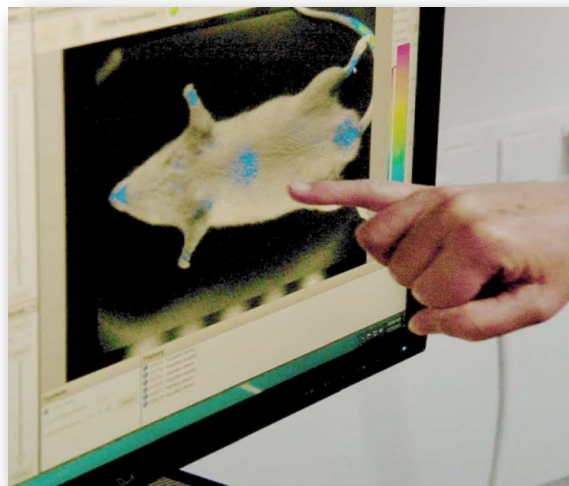
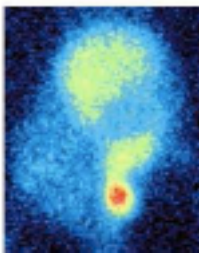
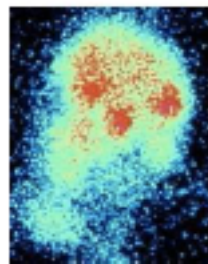
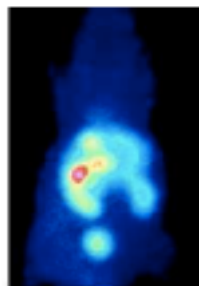
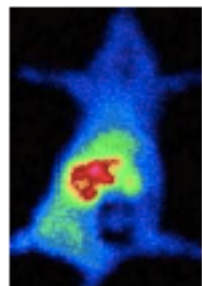
$^{188}\text{W}/^{188}\text{Re}$
generator line

^{131}I -Hipuran,
 ^{131}I -MIBG
injection
solutions line

Laboratory for preclinical research for radioisotope tests with small animals
(opened 2014)



Biodistribution and pharmacokinetics of radioactive compounds in normal and tumour-bearing mice and rats

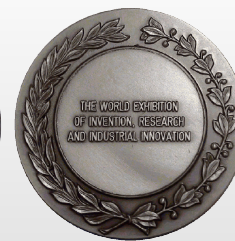




Laboratory of Radioactivity Standards

Research Projects

- Polish project „In vitro and in vivo radiometals influence on the ability imaging by the radiolabelled gastrin”
- Polish project „Alternative methods of ^{177}Lu production”
- ERA-NET project „Phase I clinical trial of ^{177}Lu -labelled gastrin receptor-localizing radiolabelled peptides for personalized diagnosis and therapy of progressive or metastatic medullary thyroid cancer”
- IAEA Project „Therapeutic radiopharmaceuticals based on ^{177}Lu - and ^{90}Y - labelled monoclonal antibodies and peptides: development and preclinical evaluations”



Itrapol & Lutapol ^{90}Y ^{177}Lu

Brussels-Eureka 2014

First in the World
medical registration of ^{177}Lu



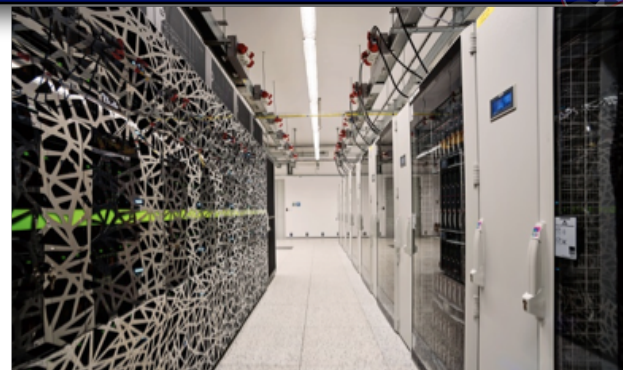
AP 120





Centrum Informatyczne Świerk

www.cis.gov.pl



- 24 M€, dedicated building
- ~Pflops, 17 PB storage
- Certified for classified data (EU and NATO)
- Computing for research (GRID)
- Support for nuclear power program (Nuclear Energy Division)
 - ✓ to perform safety assessment analysis
 - ✓ to understand severe accident phenomena
 - ✓ to study measures to mitigate the release of activity
 - ✓ to develop and assess computer models and codes

Server type	# of computers	# of cores CPU	Computing power [TF]	RAM [TB]
HP-BL685c	30	1920	17	7.7
SuperMicro TwinBlade	448	8960	200	57.3
Bullx B700	448	8960	300	57.3
Format ODYN 5248T	450	11280	450	60.2
NVidia Tesla K80	20	80	94	
Total	1396	31200	1061	182.5

Server type	Capacity [PB]
HP MDS600 (SAS)	0.6
NetApp FAS62x0 (Ethernet, NFS)	1.6
EMC Isilon HD400 (Ethernet, pNFS)	7.0
Seagate OneStore (Infiniband, Lustre)	8.0
Total	17.2



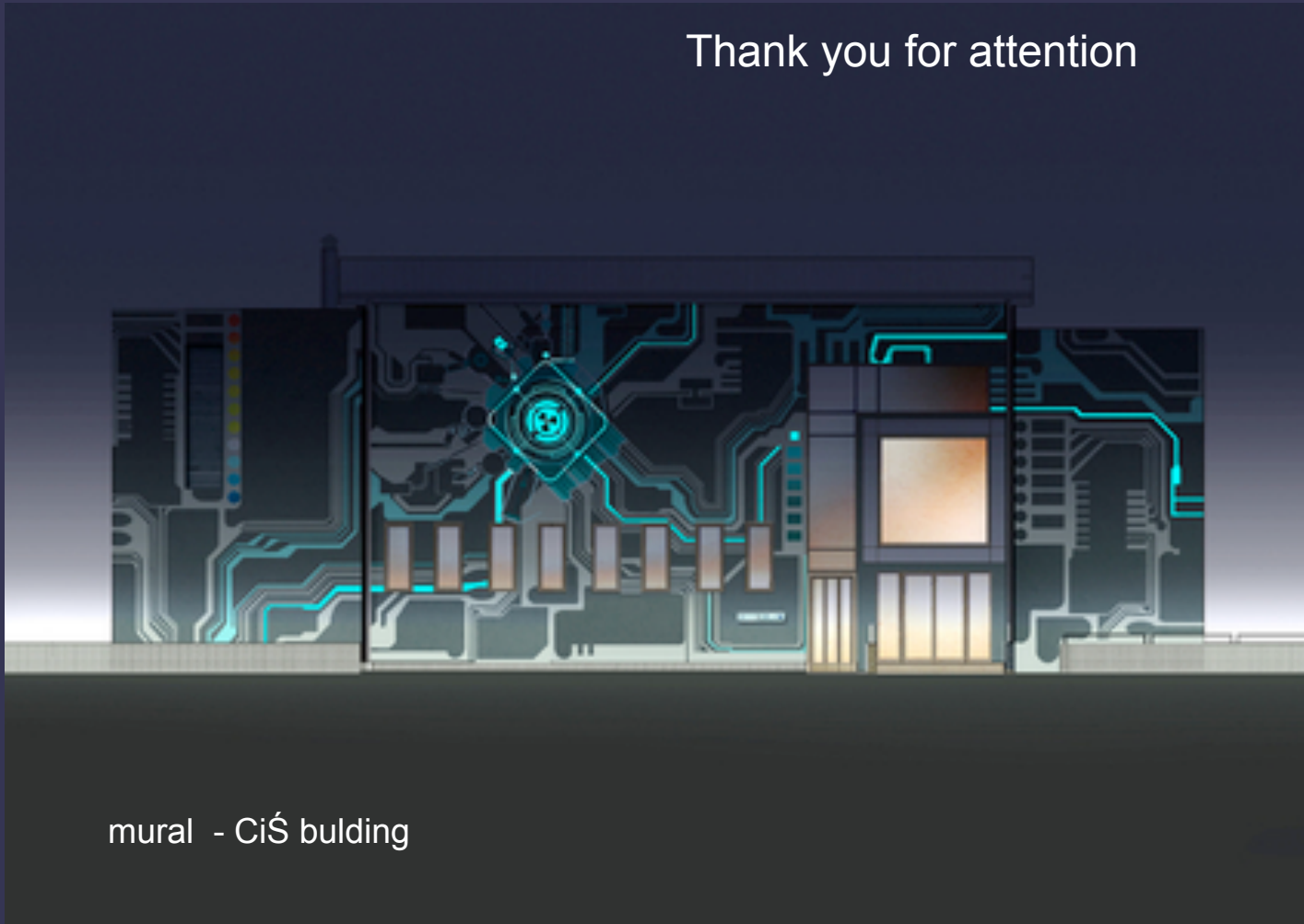
- IAEA:
 - Participation in trainings, courses and conferences;
 - Participation in TSO Forum and Advisory Meetings;
- NEA OECD
 - Representation of Poland in different Committees and Working Groups;
- Participation in NUGENIA and SNETP;
- Participation in SARNET project;
- Participation in EURATOM/FP7/H2020 projects:
 - ASGARD with IChTJ – management and transmutation of the spent fuel;
 - NURESAFE – creation of a platform of a Best Estimate Codes for nuclear industry;
 - ASAMPSA_E: Advanced Safety Assessment Methodologies: Extended PSA
 - ESNII+ - European Sustainable Nuclear Industrial Initiative;
 - NC2I-R - Nuclear Cogeneration Industrial Initiative – coordinated by NCBJ
 - ALLIANCE, VINCO (coordinated by NCBJ) part of the ALLEGRO GFR project;
 - IPPA - Implementation of Public Participation in decision making related to radioactive waste management
 - BRILLIANT – Baltic Region Initiative on Advanced Nuclear Technologies
- CEA France:
 - Training for performing calculations with CEA codes;
 - Maria reactor and JHR collaboration;
- GE-Hitachi and Westinghouse – bilateral agreements;



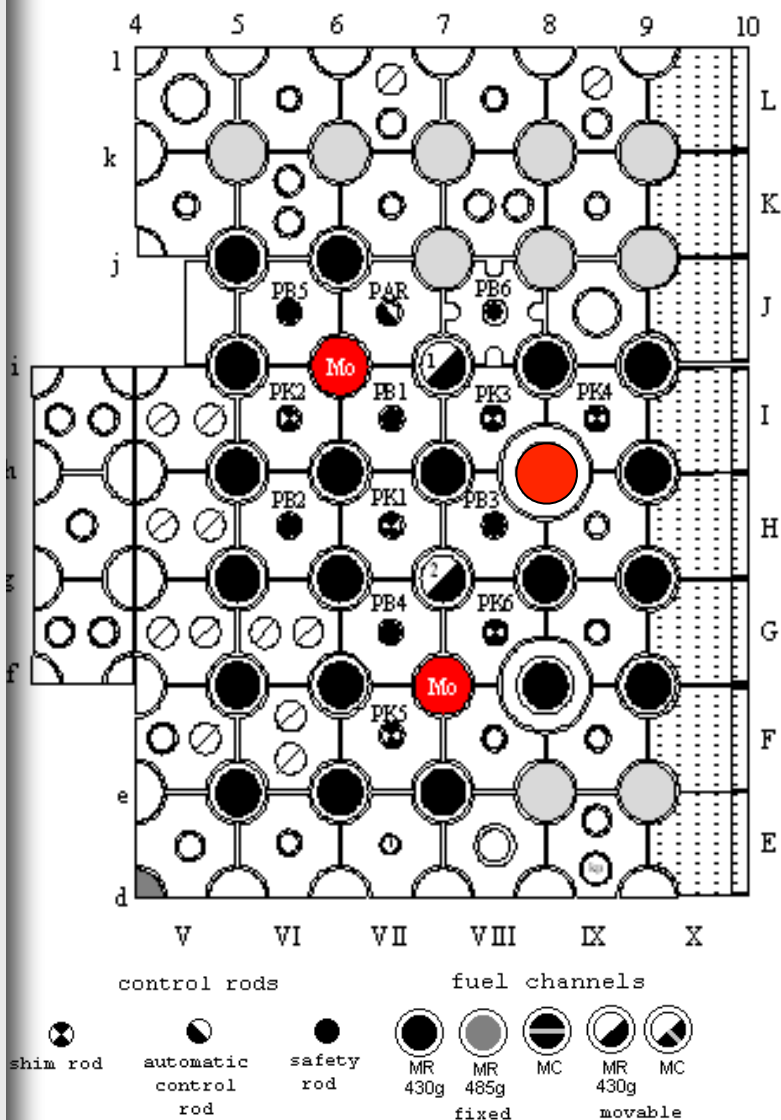
Westinghouse



Thank you for attention



mural - CiŚ building



Current cycle:

- 2×8 plates for 122-145h (weekly cycles)
- EOI: 7500-8000 Ci
- EOP: 780-830 Ci (6-days)

2013 production:

- ~20 weeks
- 18% of world production (1st semester)

Upgrade possibilities:

- ×1.5 – 12 plates per channel
- ×1.5 – using third channel
- ×2 – 40 weeks / year