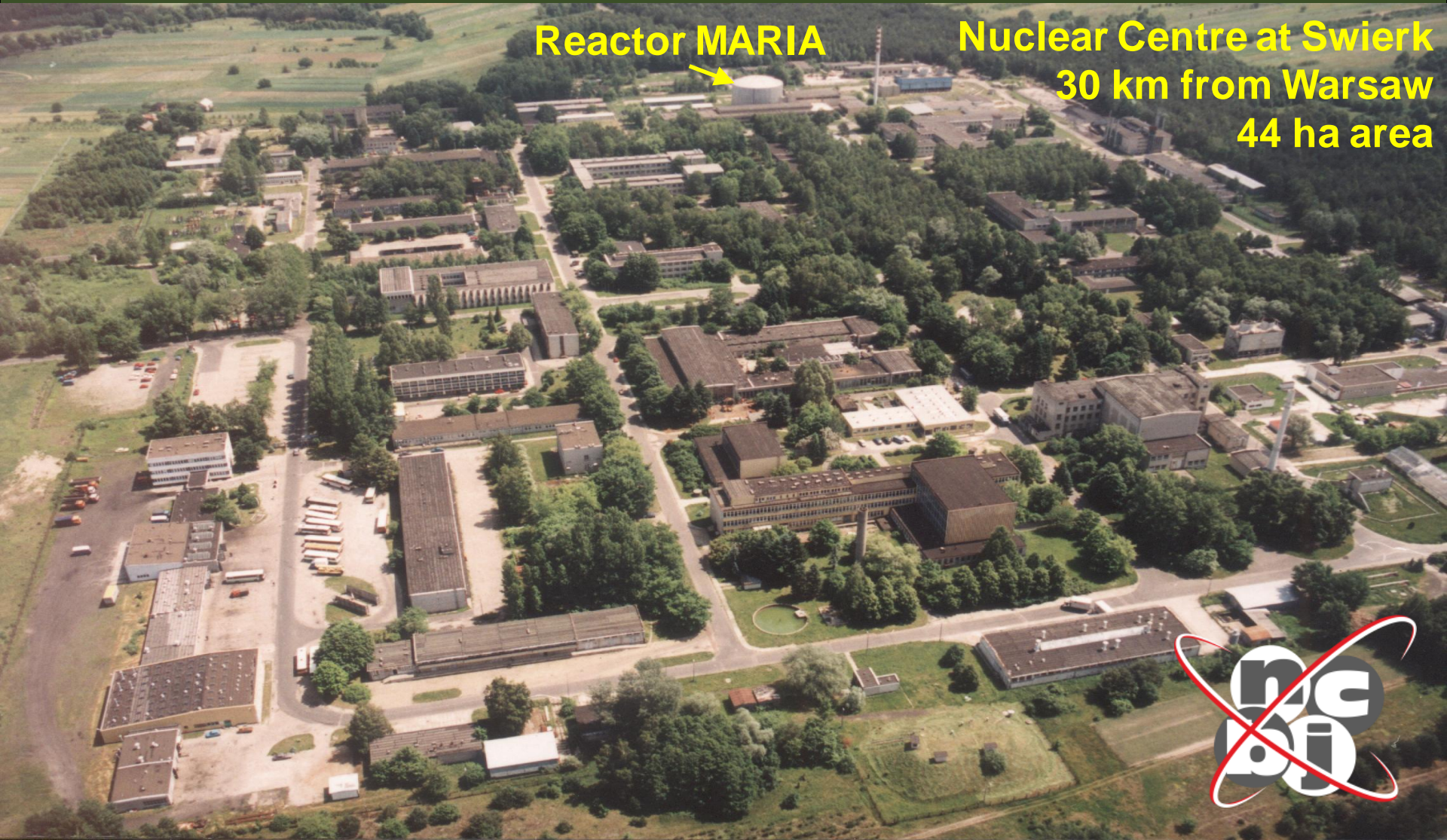


# *Accelerator R&D and construction at the National Centre for Nuclear Research*



**Reactor MARIA**

**Nuclear Centre at Swierk  
30 km from Warsaw  
44 ha area**



**Grzegorz.Wrochna@ncbj.gov.pl**

**www.ncbj.gov.pl**



- **Created 1.09.2011 by merging institutes at Świerk:**
  - **Soltan Institute for Nuclear Studies (IPJ)**
  - **Institute of Atomic Energy POLATOM**
- **Resolution of the Council of Ministers defines its role in the Polish nuclear power programme**
  - **expert support for public administration**
  - **research infrastructure for scientists**
  - **public information centre**
  - **close collaboration with other institutes**
  - **symbiosis with universities**



- **The largest research institute in Poland**
  - 1073 employees, inc. 56 prof. & 117 PhD
- **Scientific achievements:**
  - ~320 reviewed papers, 5000 quotations each year
  - Hirsh index = 42,  $\Rightarrow$  7<sup>th</sup> position in Poland
- **Incomes: ~20 M€ (2011)**
  - statutory fund 4 M€, grants/projects 7 M€
  - commercial activities 9 M€
- **Technical infrastructure**
  - ~40 ha green field, 72 000 m<sup>2</sup> routes & squares
  - networks: electricity 65 km, telecom 172 km
  - water pipelines 32 km, tanks 1900 m<sup>3</sup>



# National Centre for Nuclear Research

**Scientific Council**

**Director**  
*Grzegorz Wrochna*

## RESEARCH SECTOR

**Scientific Director**  
*Ewa Rondio*

**Deputy for Research Infrastructure**  
*Krzysztof Wieteska*

**Director of DEJ**  
*Grzegorz Krzysztosek*

**Nuclear Energy  
Department**

MARIA Reactor

**Director DBP**  
*Grzegorz Wilk*

**Department of  
Fundamental  
Research**

**Director of DFM**  
*Jacek Jagielski*

**Material  
Physics  
Department**

Material Research  
Laboratory

**Director of DTJ**  
*Agnieszka Syntfeld-Każuch*

**Department of  
Nuclear Techni-  
ques & Equipment**

Division of Nuclear  
Equipment HITEC

## FUNCTIONAL SECTOR

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Director supervised units

**Scientific Secretary**  
*Krzysztof Kurek*

**Department of  
Information  
& Education**

**Deputy for Nucl. Safety  
& Radiolog. Protection**  
*Jerzy Kozieł*

**Department of  
Nucl. Safety &  
Health Care**

**Deputy for Economy  
& Development**  
*Zbigniew Gołębiewski*

**Department of  
Economy  
& Development**

Radioisotope Centre  
POLATOM

**Administrative &  
Technical Deputy**  
*Marek Juszczyk*

**Administration  
& Technical  
Department**

Division of Transport

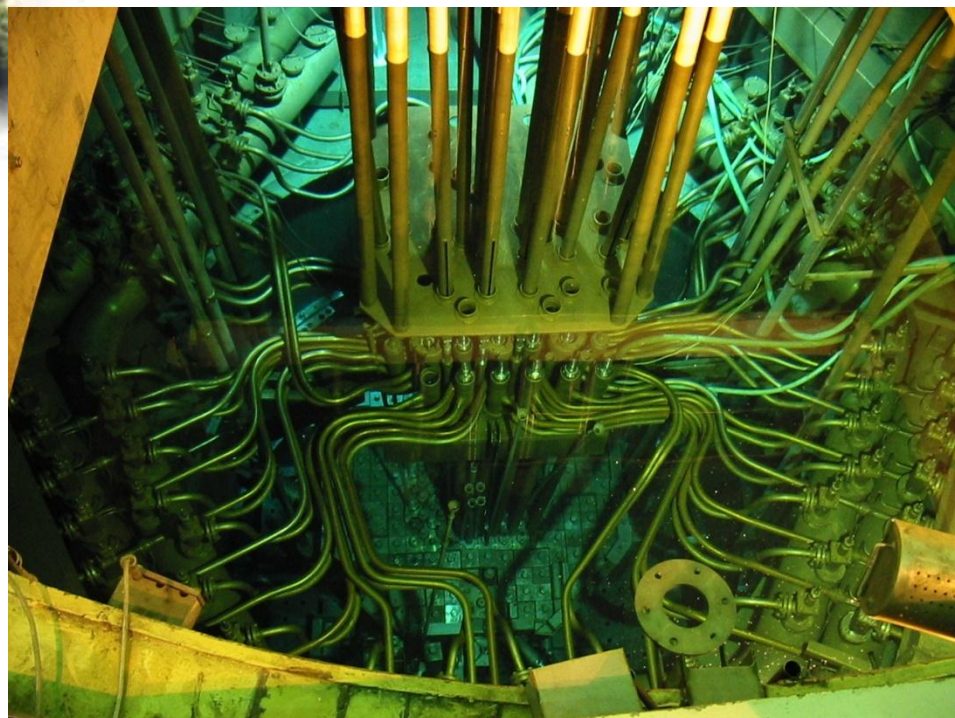


# Research reactor MARIA at Swierk



- built 1974, upgrade 1992
- neutron beam research, activation analysis, isotope production:  
 **$^{99}\text{Mo}$  for medical use**

- pool type
- $\text{H}_2\text{O}$ , Be moderated
- 30 MW thermal power
- neutron flux:
  - thermal  $4 \cdot 10^{14}$  n/cm<sup>2</sup>s
  - fast  $2 \cdot 10^{14}$  n/cm<sup>2</sup>s





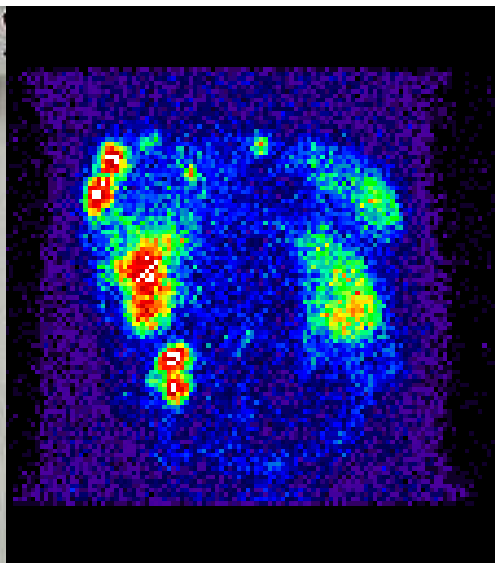
# Material Testing Laboratory



- **Hot cells, mechanical tests, structural analysis**



# Radioisotope Centre



## Development of new technologies and manufacturing:

- radioactive isotopes
- chemical compounds marked with radioisotopes
- isotope radiation sources

## Applications:

- medicine
- industry
- science





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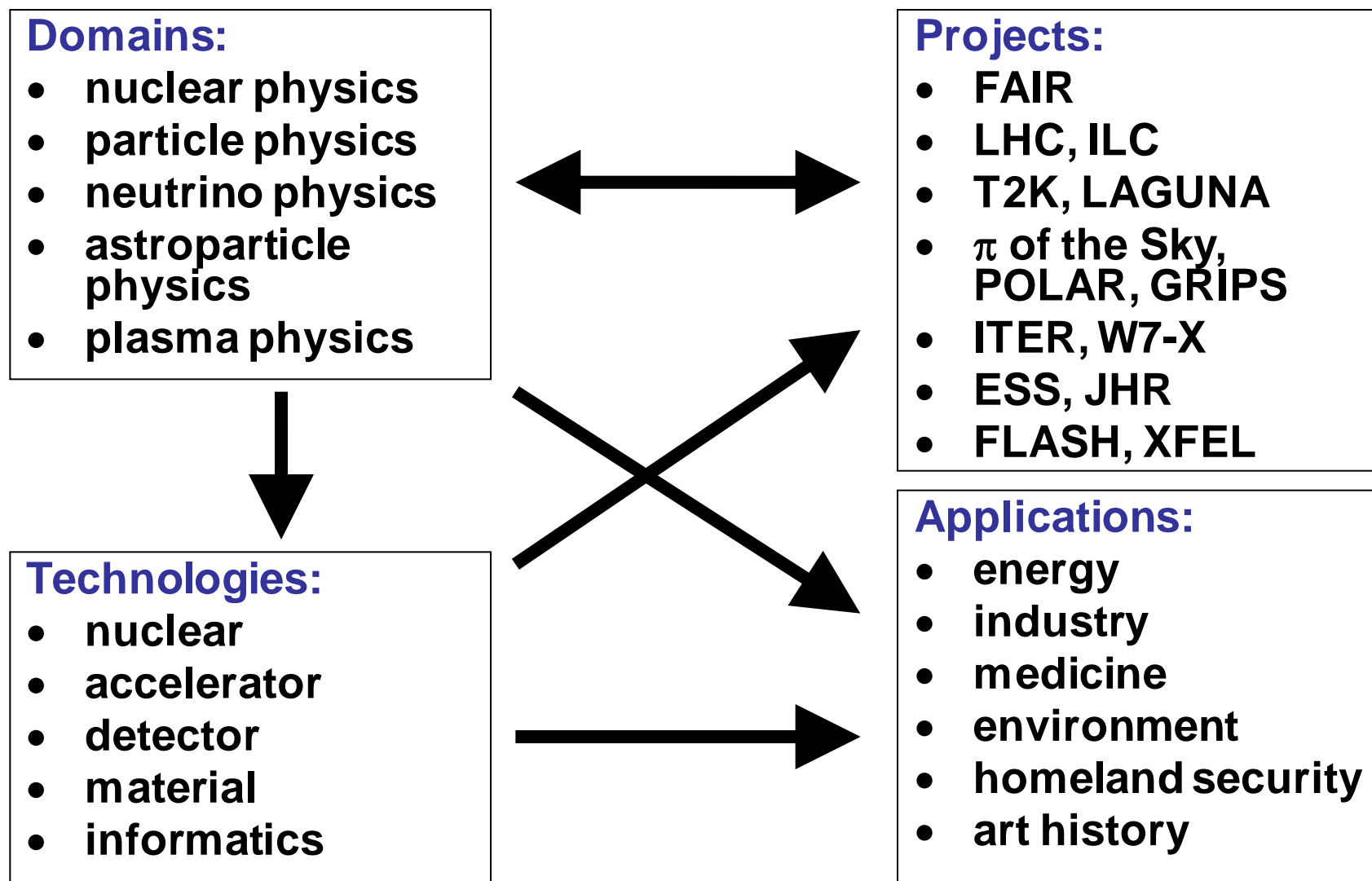
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& Technical  
Department**

Division of Transport





# Basic and applied research

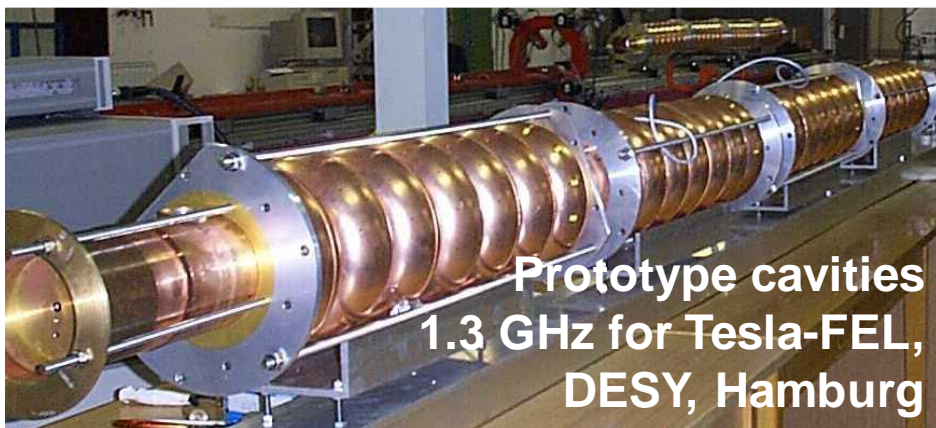




- **LHC**
  - **CMS** – muon trigger electronics
  - **ALICE** – electromagnetic calorimeter
  - **LHCb** – straw tube chambers
  - **LINAC4** – proton buncher & PIMS
- **XFEL** – higher order mode absorbers, LLRF
- **FAIR** – PANDA & CMB detectors, e<sup>-</sup> cooler?
- **ITER** – plasma diagnostics
- **W-7X** – neutral beam injection
- **ESS** – radiation calculations
- **JHR** – under discussion



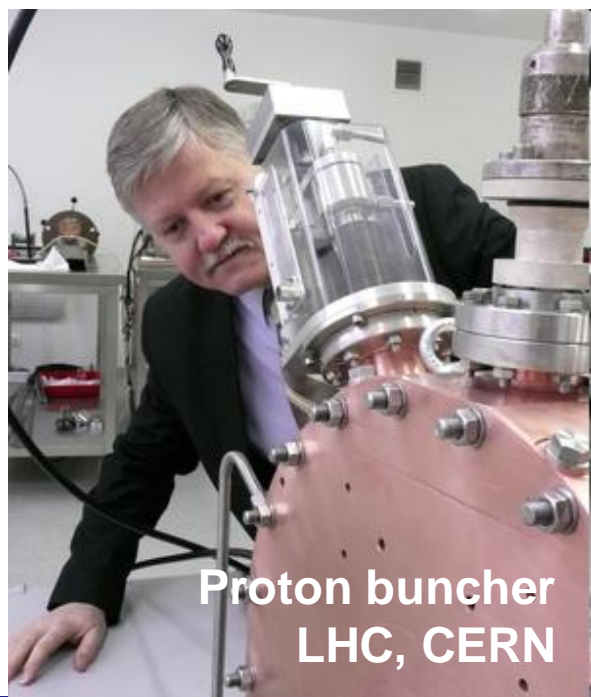
# Components for large experiments



Prototype cavities  
1.3 GHz for Tesla-FEL,  
DESY, Hamburg



Target for experiment  
Isolde, CERN, Geneva



Proton buncher  
LHC, CERN



Linac4 PIMS  
LHC, CERN



# Accelerators for industry and medicine



- **Sterylisation**
- **Radioteraphy**
- **Radiography**



## Inspection of

- bridges spans
- welds
- frames
- pressure pipes
- castings
- containers
- elements made of steel



**Lillyput - 3**  
Industrial  
Accelerator





# *Lillyput 3 for nondestructive inspection*

- **Stationary and mobile configuration**
  - **X-ray head with integrated modulator and inner cooling system**
  - **Computer controlled**
  - **Photon energy 6 & 9 MV**
  - **Maksimum dose rate 20 Gy/min \***  
**(10x10 cm<sup>2</sup> field in 1 m distance from target)**
- \* Without flattening filter**





# Lillyput 3 – mobile version





# *COLINE linear accelerators for radiotherapy*

- **Used in standard and conformal radiotherapy**
- **Several models: energy from 4 to 20 MeV**
- **Digitally controlled**
- **Compact and reliable design**
- **With optional multileaf collimator and electronic portal imaging system**
- **Ready to connect to therapeutic line**



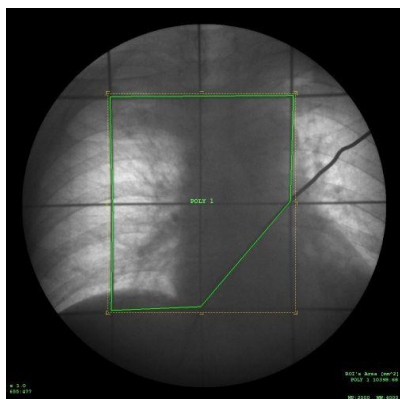




# Not only accelerators

## All components for treatment:

- Treatment Planning Systems
- X-ray simulators
- Therapeutic tables
- Mould-room equipment
- Protecting doors, shielding ...





# Accelerator R&D and construction

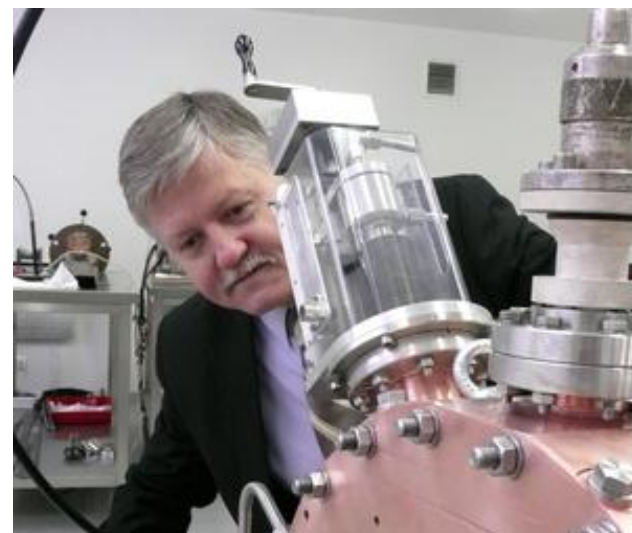
## Division of accelerator physics and technology

- lead by Dr Sławomir Wronka
- 25 employees



## Division of Nuclear Equipment HITEC

- lead by Dr Paweł Krawczyk
- 108 employees





# Machines at HITEC Świerk

2008



2009





# *National Centre for Nuclear Research*

- **Nuclear technologies for medicine and industry**



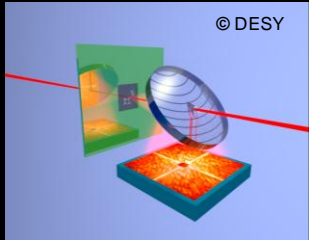
- **Interface between research and industry**
  - office & lab space, administrative & social support
- **Specialised in particle accelerators & detectors**
  - vacuum, cryogenic & magnet technologies



# Free Electron Laser @ Świerk

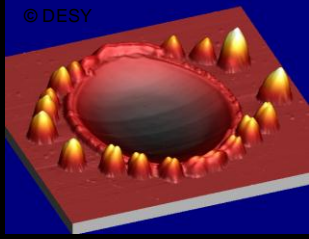
4<sup>th</sup> generation light source driven by electron accelerator

© DESY



**3D-imaging:**  
molecules  
& nano-  
structures

© DESY



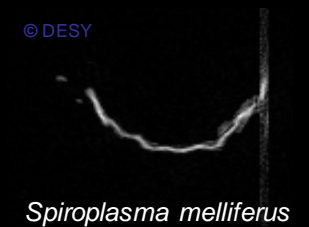
**Material  
studies:**  
dense plasma  
properties

© DESY



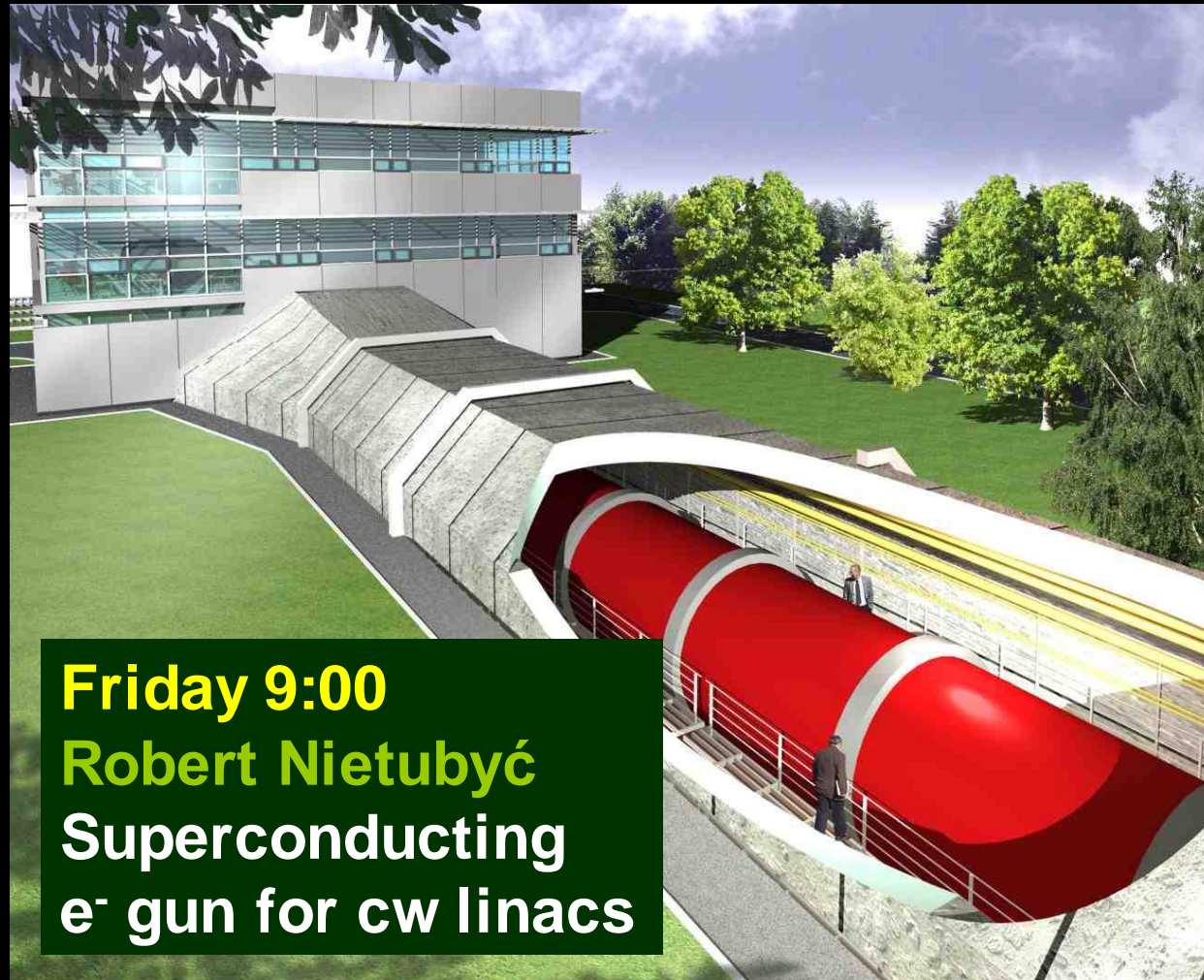
**Novel  
technologies:**  
surface  
modification

© DESY



*Spiroplasma melliferus*

**Live  
sciences:**  
biological cell  
imaging



**Friday 9:00**  
**Robert Nietubyć**  
**Superconducting  
e<sup>-</sup> gun for cw linacs**

Continuous e<sup>-</sup> beam E → **600 MeV**  
Radiation wavelength: **THz** → **UV 9 nm**  
Pulse length: **< 100 fs**

Beam power (peak): **0.22 GW**  
Length: up to **400 m**  
Cost: **100 M€**



# Conclusion on accelerator R&D @ NCBJ

We deal with

- low budget
- old infrastructure
- generation gap

but ...



# we can do miracles!