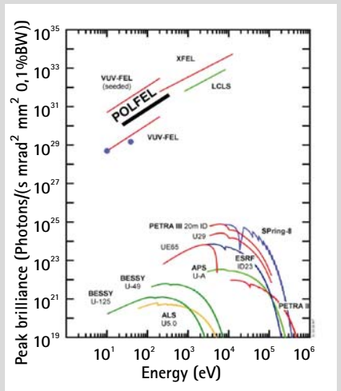
POLFEL
Free Electron Laser @ Świerk

The Polish Free Electron Laser (FEL) is a fourth generation light source with 100 000 times more powerful pulses than the third generation sources synchrotrons. Light pulses shorter than 100 femtoseconds (10^{-13} s) are produced by electrons speeded up by a linear accelerator.

POLFEL basic parameters:

- Continuous electron beam with energy **600 MeV**
- Radiation wavelength: **UV**, primary - 27 nm, 3rd harmonic - 9 nm
- Pulse length: < 100 fs
- Maximum beam power (peak): **0.22 GW**
- Length of the device: up to **400 m**
- Cost: 100 **M€** (single station) - **200 M€** (6 stations)



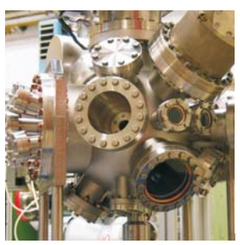
POLFEL for science, innovation and technology

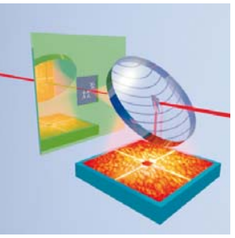
Images courtesy of DESY

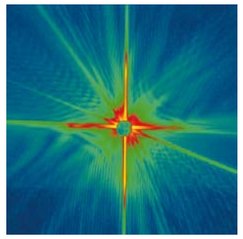
- A research and training center for fundamental, material, environmental, medical and biological research.
- The core facility of Technology Park for transferring research results into industrial technologies
- A training and development center for laser, accelerator and detection technologies.

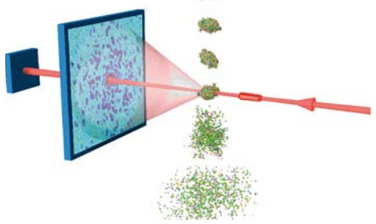
Research potential:

- Studies of electronic properties of molecules, condensed matter and dense plasma
- 3D-imaging of atomic structures
- Registration of physical, chemical and biological properties on the atomic and femtosecond scale







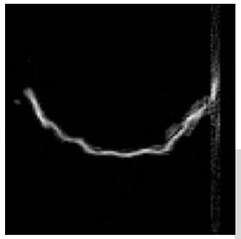


Diffractive imaging of nanostructures and large molecules

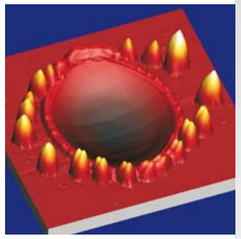
Examples of applications:

- Tests of quantum chromodynamics in the low energy range (<500MeV)
- Semiconductor and quantum structure studies:
  - phonons, plasmons, binding energies of dopants, energetic levels in quantum wells, wires and dots, relaxation dynamics
  - development of THz and MEMS technologies: hybrid antennas, mixers, filters
  - pump/probe technique:
  - carrier dynamics in superstructures, intraband interactions, cascade lasers
  - absorption in quantum wells and in superstructures, width of emission lines, dispersion
  - optical properties in the infrared and THz ranges of such structures as: Bloch oscillators and quantum cascade lasers
  - coherent resonant effects, Rabi oscillations
- Near-edge microscopy and spectroscopy
- Environmental studies using photo-thermal spectroscopy (PTDB)
- Analysis of atmospheric processes in real time using tunable lidar
- Biomolecular spectroscopy
- Medical diagnosis: precise visualization of organs, identification of molecules
- Medical therapy: FEL-activated nanoplatforms
- Selective destruction of damaged or ill cells via tunable radiation

Biological cell imaging



Surface damage studies

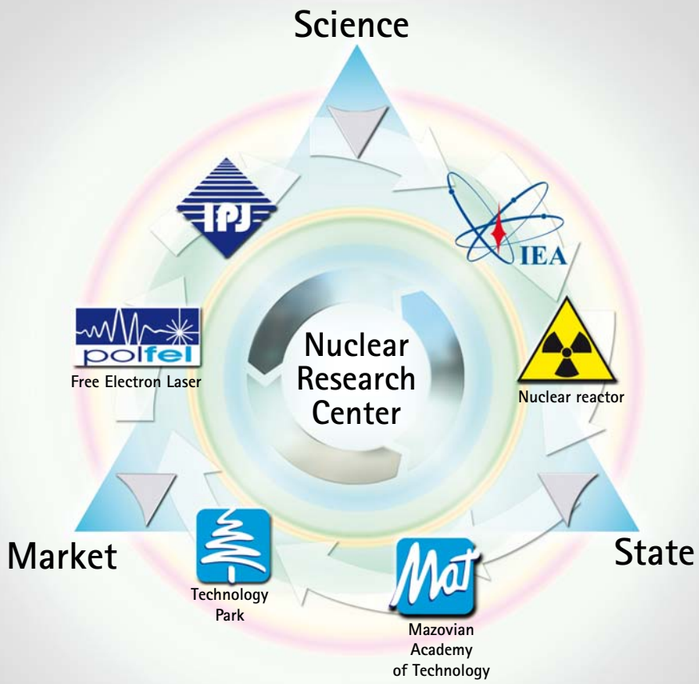


Making periodic surface structures

Świerk the host laboratory

The nuclear research center in Świerk, near Warsaw, is well prepared to host POLFEL. The protected area of 44ha has a technical infrastructure matching nuclear reactor requirements (e.g. 3 independent power lines), security and safety networks serving nuclear reactor MARIA. The site hosts two national labs: *The Andrzej Soltan Institute for Nuclear Studies* (IPJ) and the *Institute of Atomic Energy* (IEA), each having almost 500 employees. The staff has high expertise in designing, buiding and opearting large research facilities like nuclear reactors and particle accelarators.

Light in the tunnel for Polish high-tech industry and Mazovia region



Lack of large scale research facilities in Poland is a barier for developing high-tech industry. POLFEL shall become a facility concentrating activities of scientific institutes (IPJ and IEA), the Techno-Park and Mazovian Academy of Technology educating experts for nuclear technologies to be utilized for power generation, industry, medicine, environment protection and security systems. It shall attract young people eager to learn modern science and novel technologies. It shall radiate ideas to be developed in spin-off companies growing in industry incubator. This part of the Mazovia region shall profit a lot from the new life of Świerk.