



Project co-financed by the European Regional Development Fund through the Competitiveness Operational Programme
"Investing in Sustainable Development"



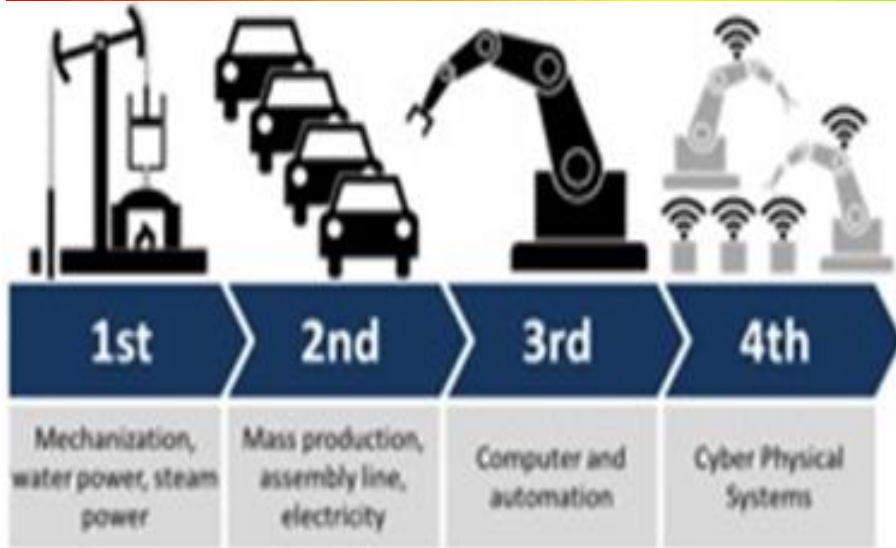
Extreme Light Infrastructure-Nuclear Physics
(ELI-NP) - Phase II



At the forefront of new Industries in Romania Extreme Light Infrastructure-Nuclear Physics ELI-NP

ELI – NP Project Implementation Team

Industry 4.0



- ✓ 4th Industrial Revolution concept – proposed and implemented by Germany (2011) followed and developed by all industrialized countries
- ✓ Based on research and innovation achievements
- ✓ Research is going on

What about Romania?

Disruptors:

- a rise in data volumes
- computational power and connectivity
- emergence of analytics and business intelligence capabilities – e.g. new forms of human-machine interaction such as touch interfaces and augmented-reality systems
- improvements in transferring digital instructions to the physical world such as advanced robotics and 3D printing.

The issues:

- Intelligent Decision-Making and Negotiation Mechanism:
- High Speed IWN Protocols
- Manufacturing Specific Big Data and Analytics
- System Modeling and Analysis
- Cyber Security:
- Modularized and Flexible Physical Artifacts:
- Investment Issues

Ro Industry 4.0 ~~If/When~~, Today, What ELI-NP ...

Can DO:

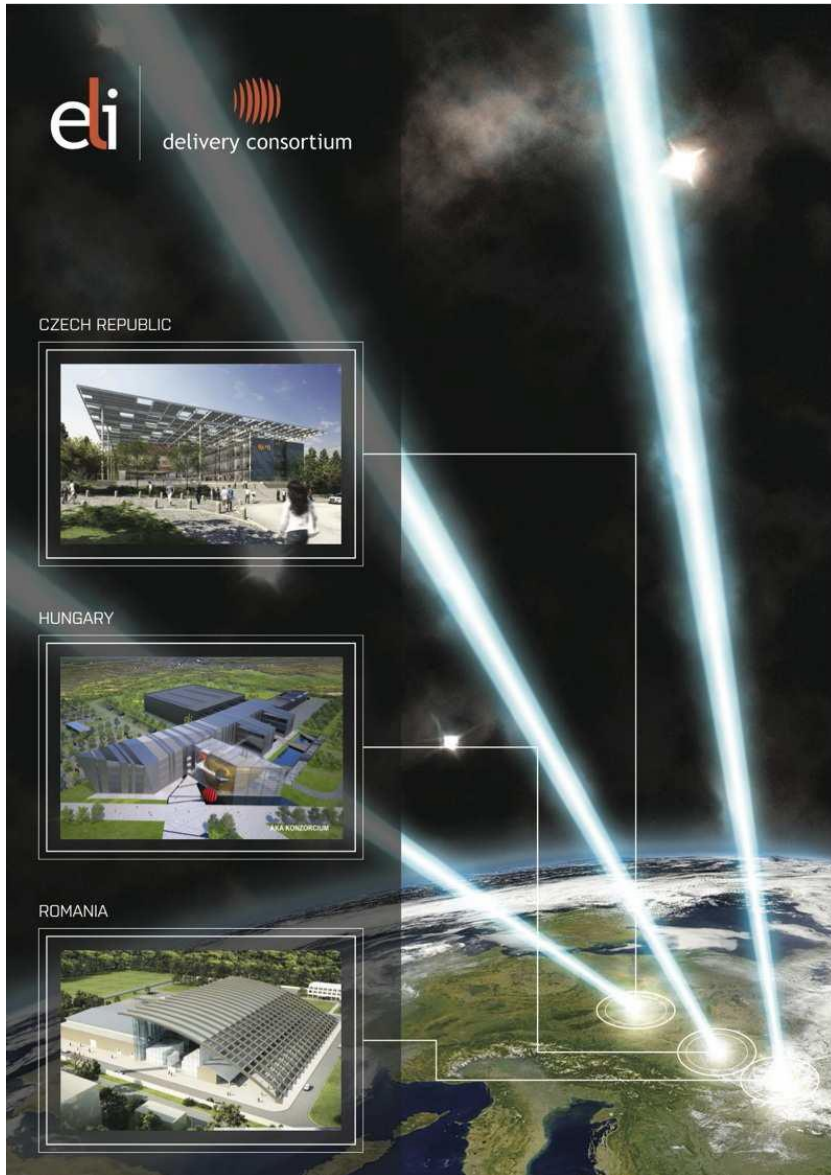
- To offer a virtuous example of integrating people, things, data, services
- To create knowledge and trained educated people
- To transfer technologies and knowledge
- To be open and inspirational for young generations of scientists, engineers, technicians and entrepreneurs
- To support innovation by new high-tech industries around: as suppliers or beneficiaries of research results

Can CONTRIBUTE/COLLABORATE:

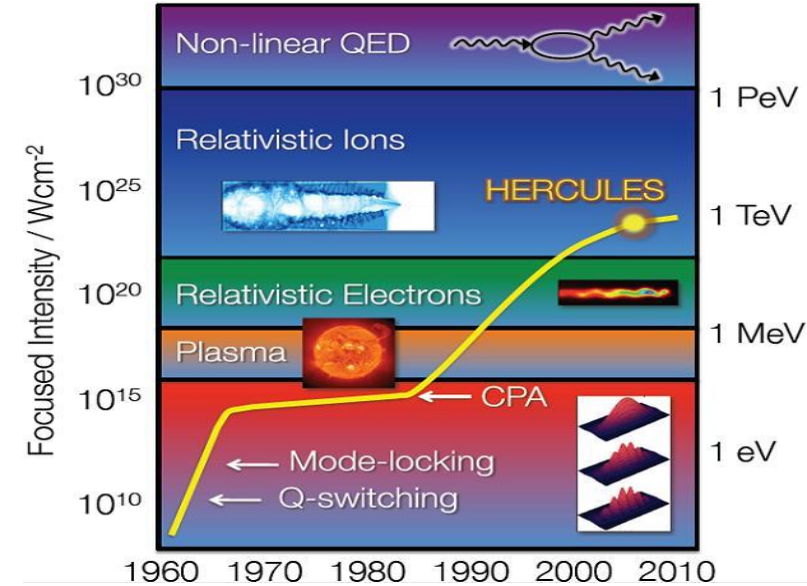
- To Develop/to offer new/disruptive technologies and solutions addressing the issues: complex systems, detectors and sensors, computational power, big data, resources management, cyber security, additive (advanced) manufacturing, smart product
- To achieve the objectives of the Advanced Initiatives for regional and national development

Extreme Light Infrastructure (ELI)

The world's most advanced Laser Research Infrastructure



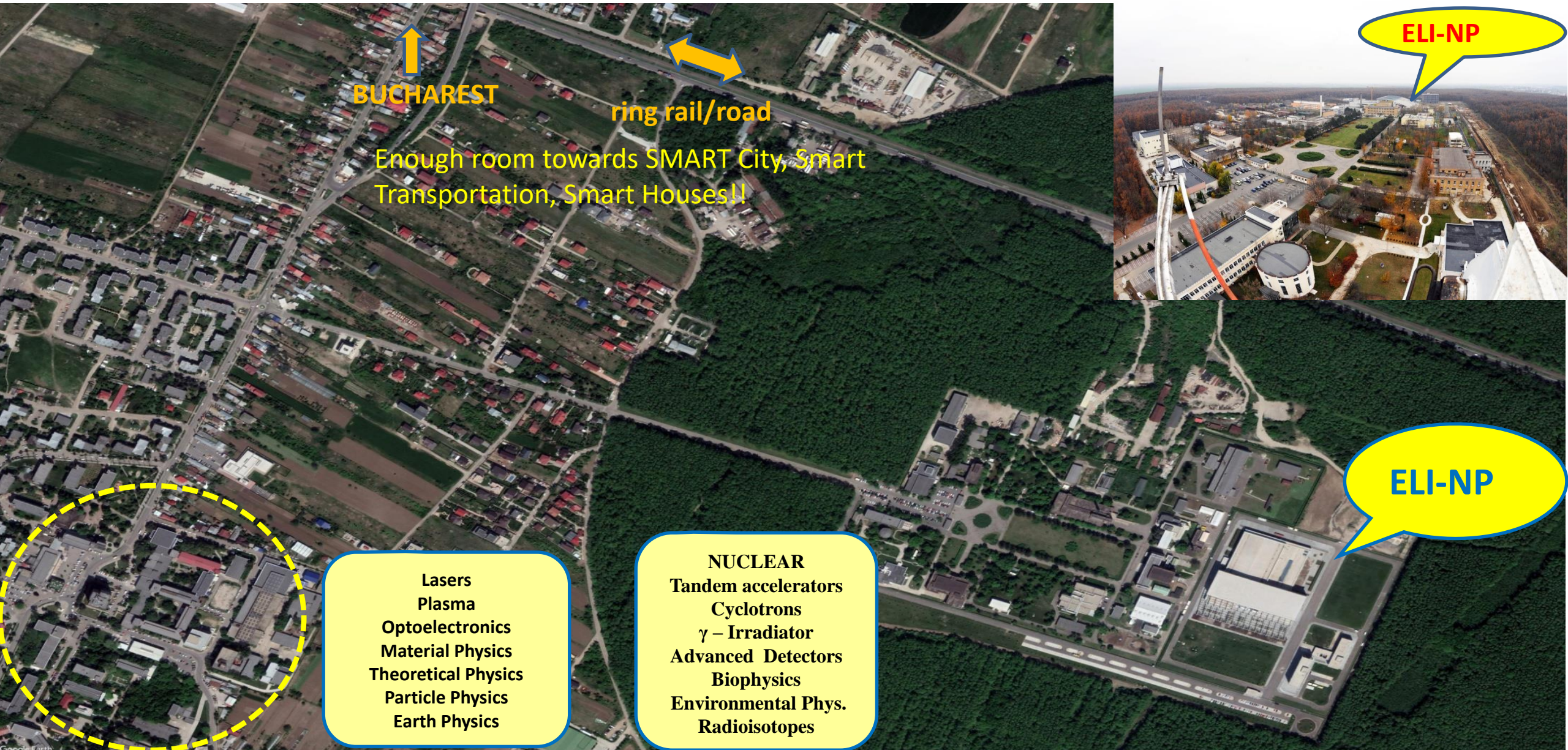
Gerard Mourou
(Nobel 2018)



ELI – ESFRI Landmark:
ELI–Beamlines, Prague, CZ
ELI–Attosecond, Szeged, HU
ELI–Nuclear Physics, Magurele, RO



Bucharest-Magurele National Physics Institutes



BUCHAREST

ring rail/road

Enough room towards SMART City, Smart Transportation, Smart Houses!!

ELI-NP

ELI-NP

Lasers
Plasma
Optoelectronics
Material Physics
Theoretical Physics
Particle Physics
Earth Physics

NUCLEAR
Tandem accelerators
Cyclotrons
 γ - Irradiator
Advanced Detectors
Biophysics
Environmental Phys.
Radioisotopes

SMART Facility, SMART Building

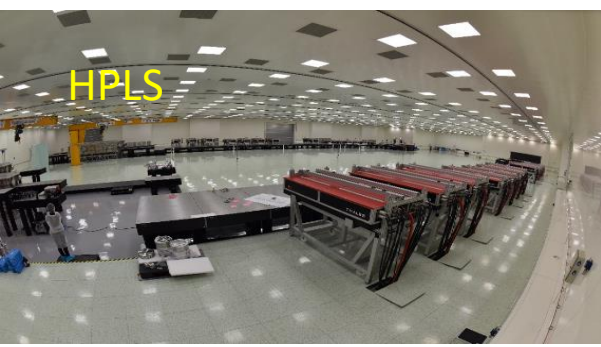
Special building and all infrastructures fully operational

10 ha, total built area: 33000 m²

- Office Building
- Guest House
- Canteen



Geothermal System



HPLS



Laboratories
Experiments



GBS

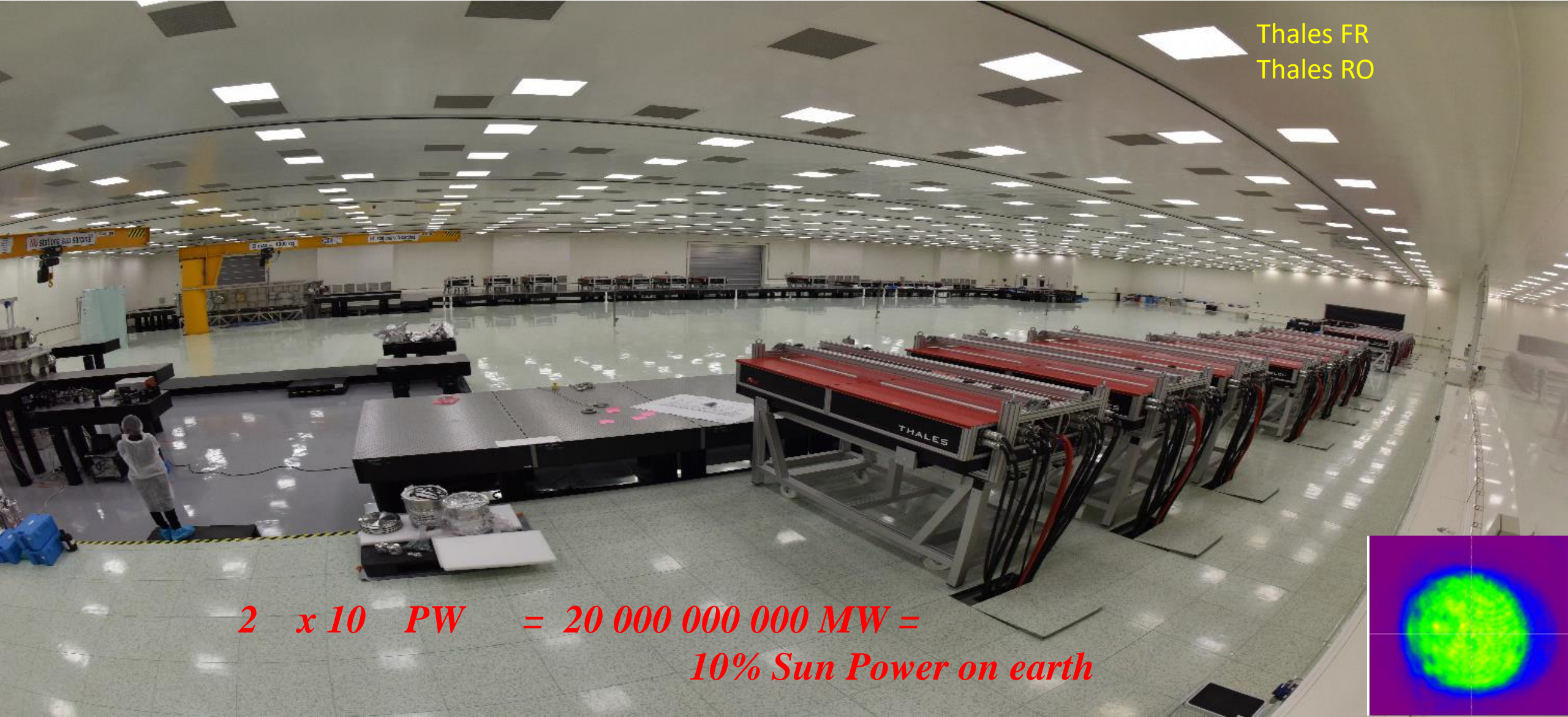


Antivibration Platform

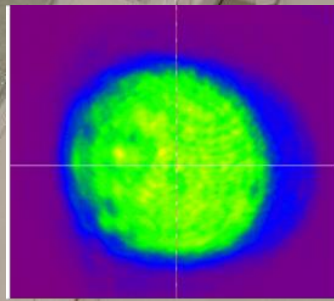
ELI-NP High Power Laser System

Confirmed: May 2018 – 3 PW, February 2019 – 7 PW, very soon 10 PW

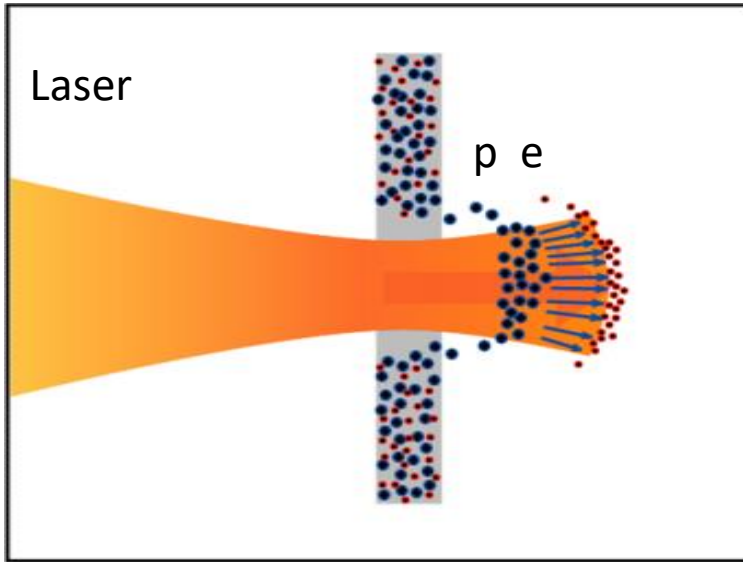
Thales FR
Thales RO



$2 \times 10 \text{ PW} = 20\,000\,000\,000 \text{ MW} =$
10% Sun Power on earth

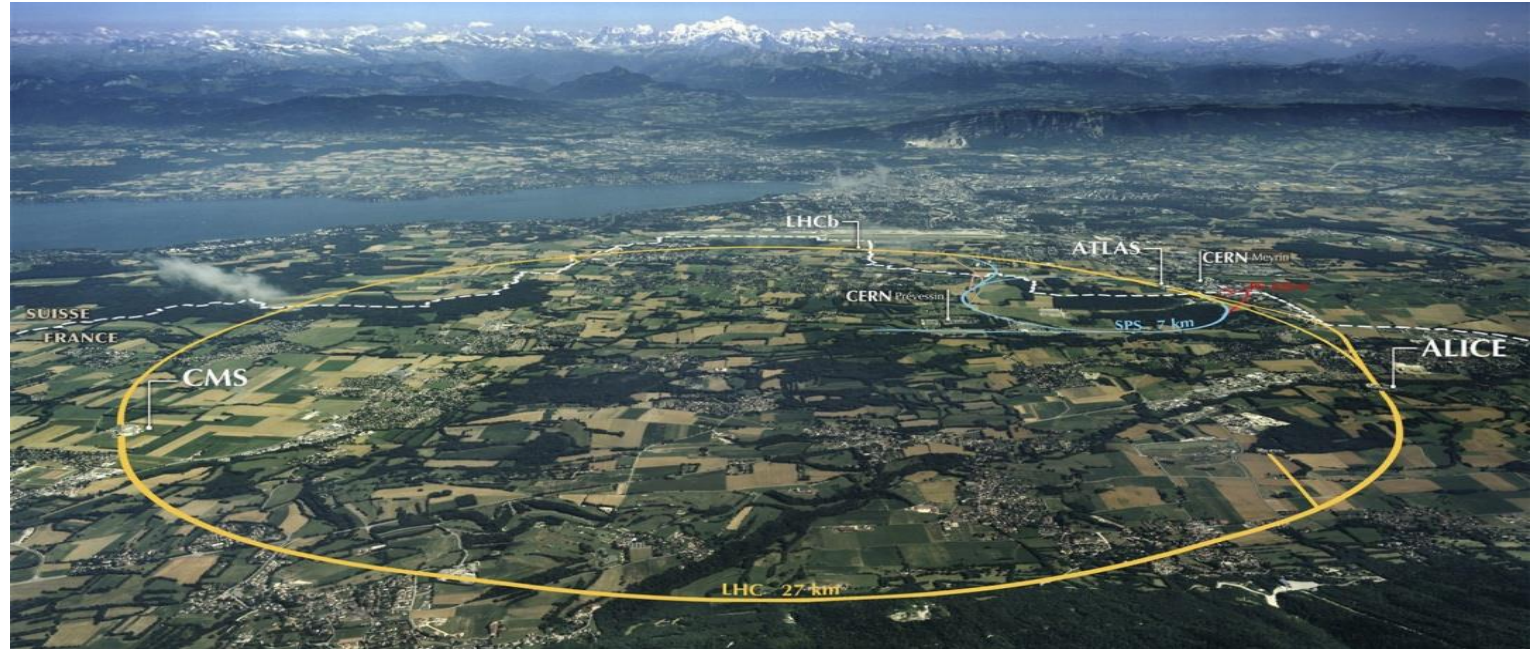


Particle acceleration by laser a new paradigm...



$E \sim 10^{15} \text{V/m}$

Electrons and ions accelerated at solid state densities 10^{24}cm^{-3} (Classical beam densities 10^8e cm^{-3})
on very short distance (μm - mm)



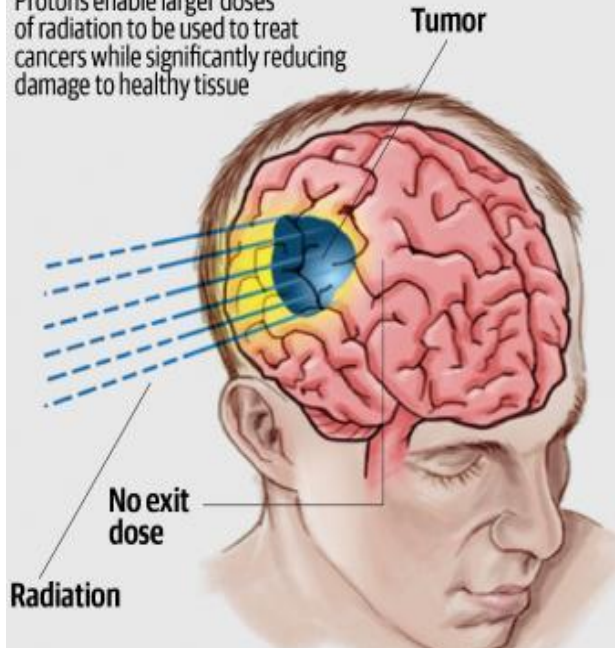
CERN - Geneva

*...and a huge potential of developing new/disruptive technologies
and applications*

High medical impact applications of PW lasers

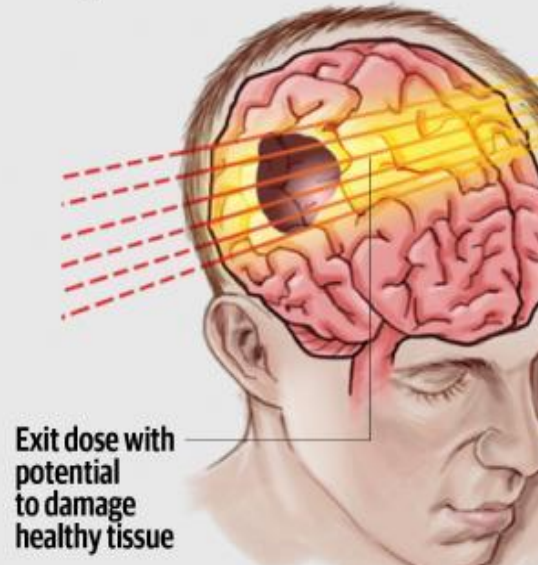
PROTON THERAPY

Protons enable larger doses of radiation to be used to treat cancers while significantly reducing damage to healthy tissue



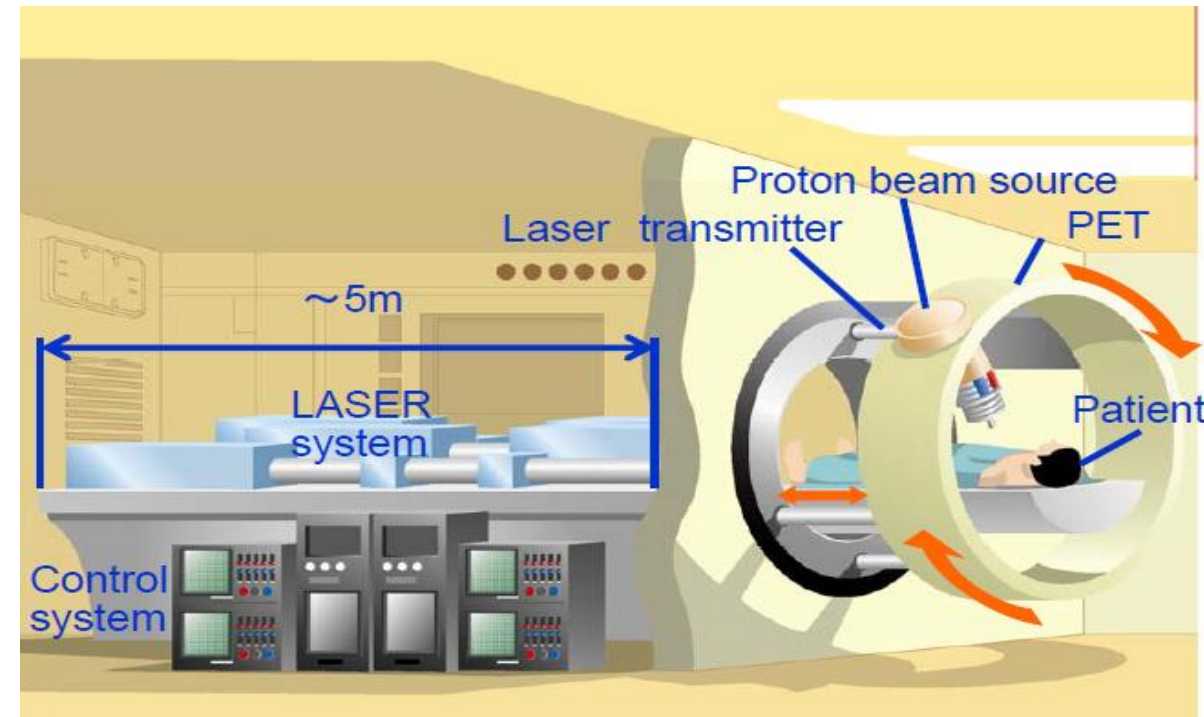
TRADITIONAL X-RAY THERAPY

Smaller doses of radiation are used to reduce damage to healthy tissue due to the inability to restrict radiation pattern to cancerous tissue



Laser driven proton therapy

PW lasers can make hospital size proton accelerators

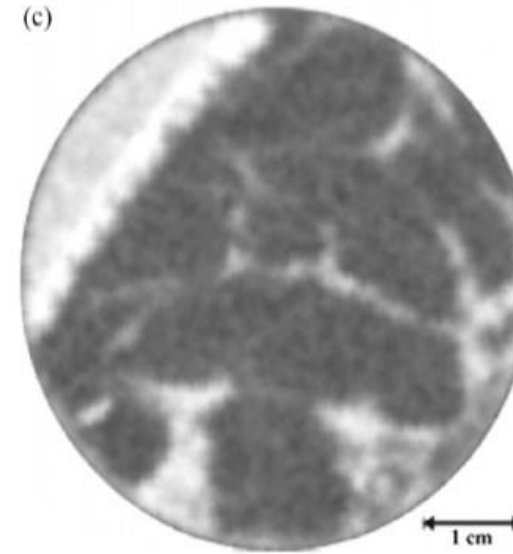


Medical Imaging

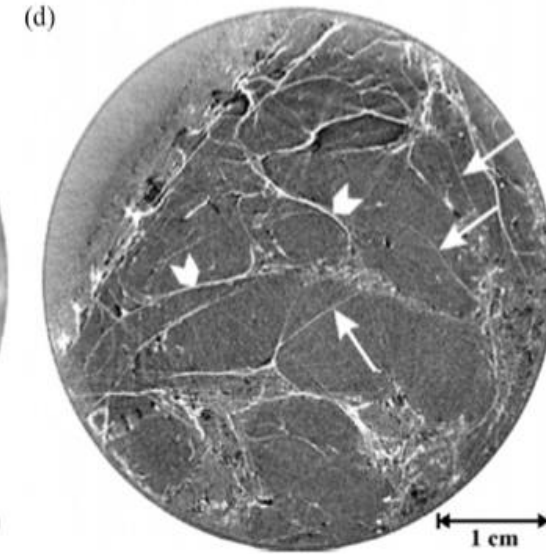
Phase-contrast mammography station at ELETTRA synchrotron



Conventional

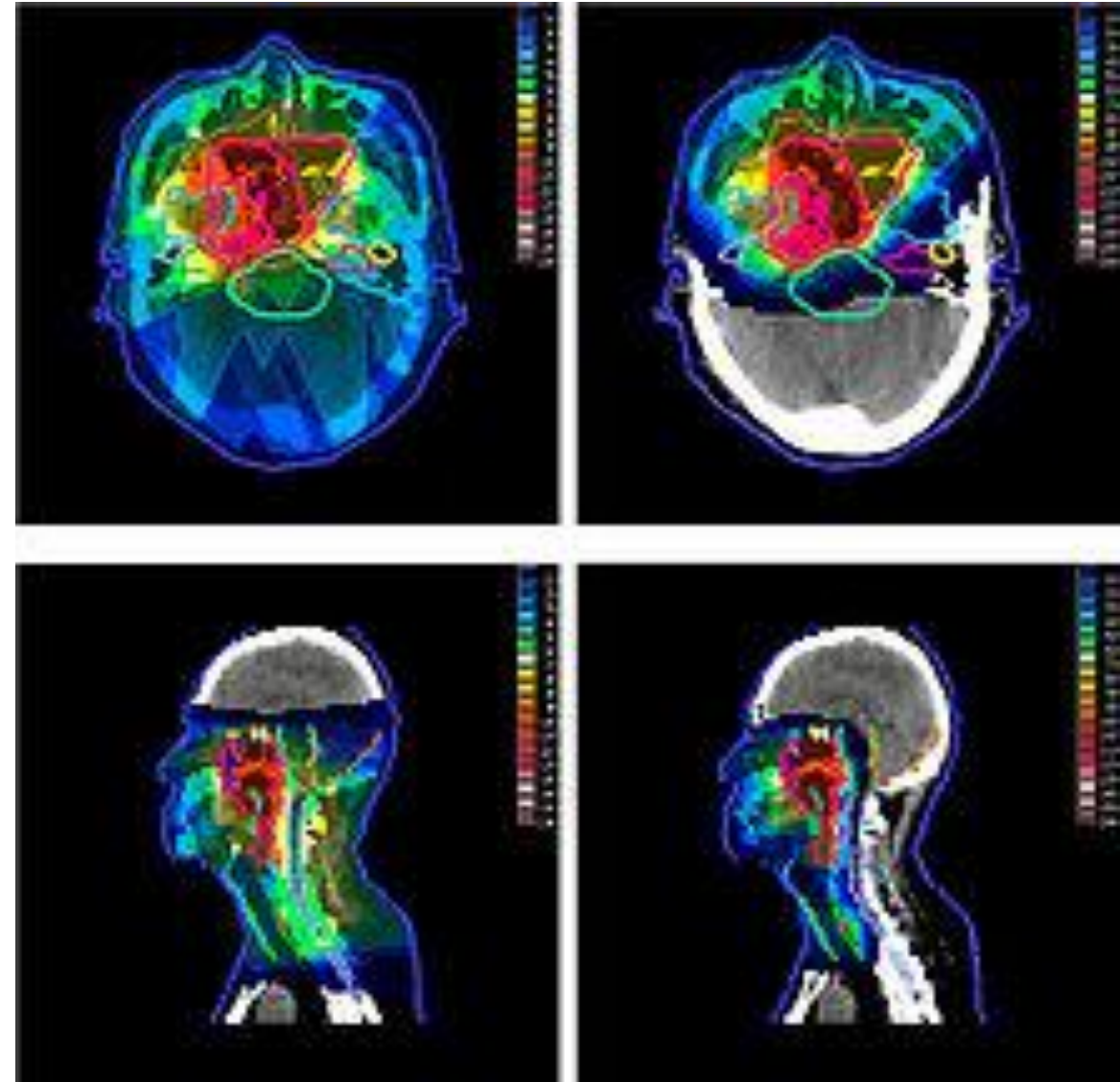


Phase-contrast



Radio - pharmaceuticals

- Establish methods for production of already commercial or new radioisotopes for imaging and treatment
- New radioisotopes
 ^{195m}Pt : In **chemotherapy of tumors** it can be used to exclude "non responding" patients from unnecessary chemotherapy and optimizing the dose of all chemotherapy



Potential Nuclear Photonics Applications



HEU Grand Challenge
detection of shielded material



Nuclear Fuel Assay
100 parts per million per isotope



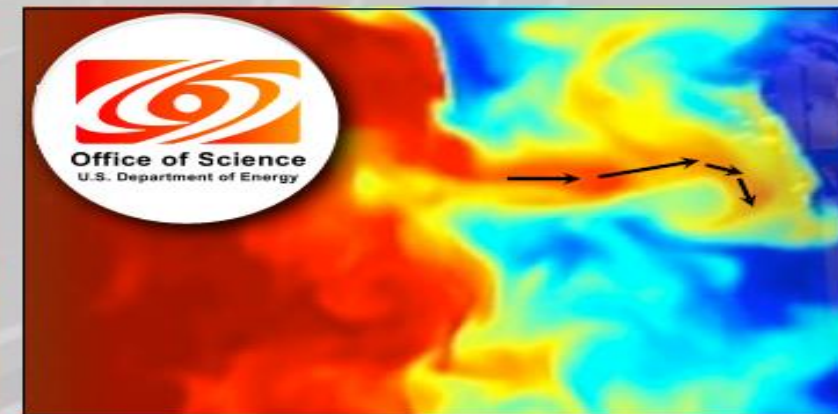
Waste Imaging & Assay
non-invasive content certification



Precision Imaging
micron-scale & isotope specific



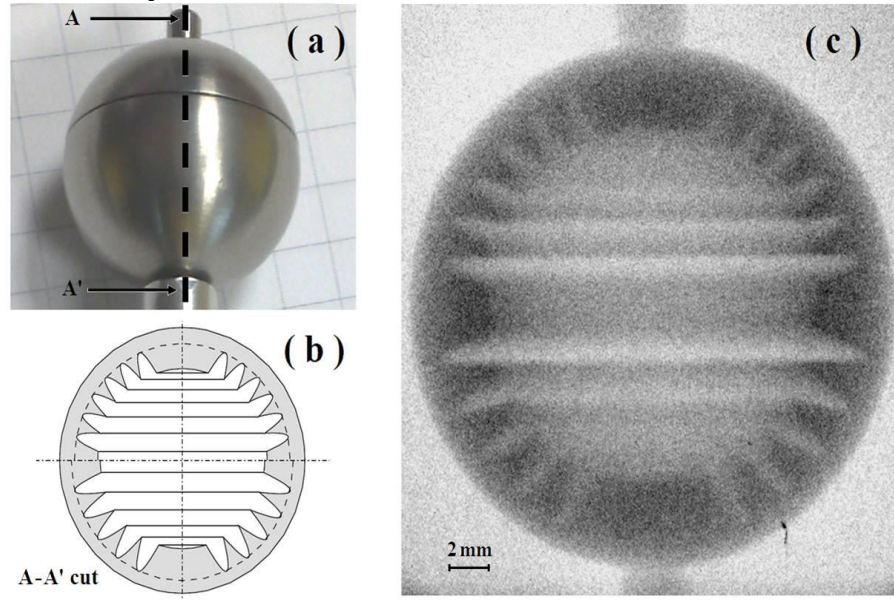
Medical Imaging
low density & isotope specific



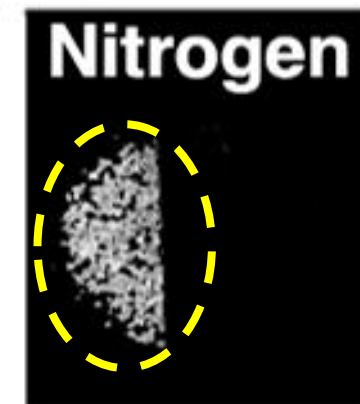
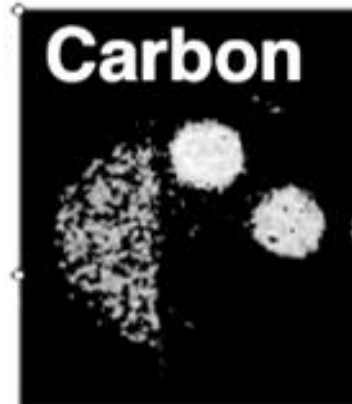
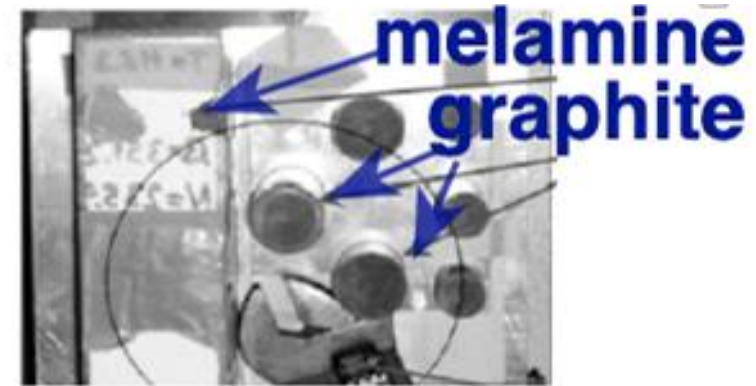
Dense Plasma Science
isotope mass, position & velocity

Laser driven gamma-ray radiography

Tungsten object



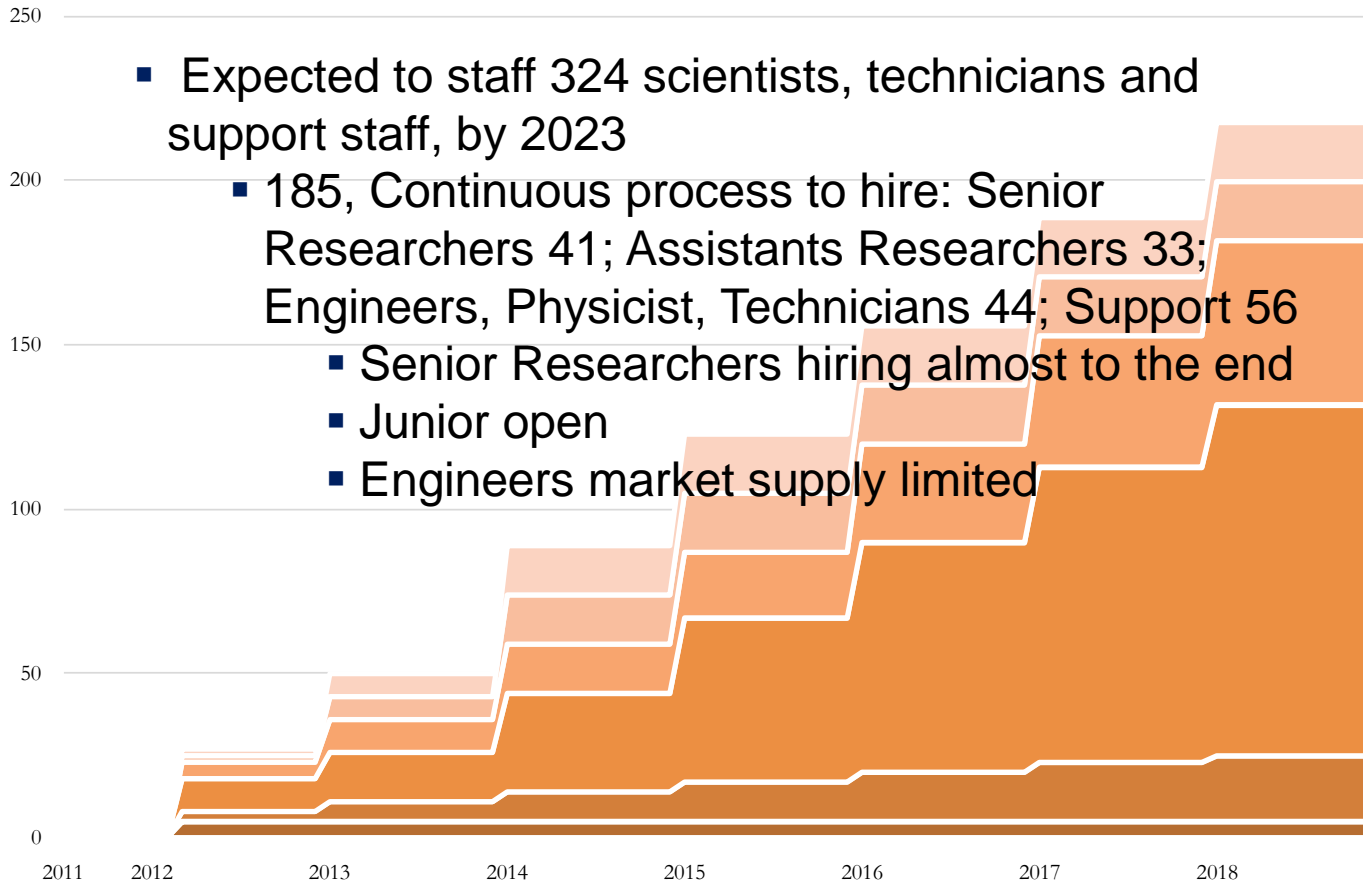
Laser driven TOF neutron radiography



- Ultrafast radiography of large objects (jet engines, defense apps)
- Portal detection of 'sensitive' materials

Smart people

- Expected to staff 324 scientists, technicians and support staff, by 2023
 - 185, Continuous process to hire: Senior Researchers 41; Assistants Researchers 33; Engineers, Physicist, Technicians 44; Support 56
 - Senior Researchers hiring almost to the end
 - Junior open
 - Engineers market supply limited



Collaboration:

- ✓ With Doctoral Schools of Politehnica University of Bucharest, University of Bucharest, West University from Timisoara
- ✓ With more than 60 internationally renowned universities and research institutions



Smart partnerships and governance...towards regional development & New Industries

- ***ELI-NP Industrial Forum***
 - *framework of dialogue between research and industry*
 - *promotion of contractual research, technology transfer, innovation, etc.*
 - *forming a cluster of high-tech companies in Magurele*
- ***“Magurele High Tech Cluster”***
 - *89 members*
 - *meetings with business representatives (organized by Embassies): UK, Japan, Czech Rep., Switzerland, Germany, Israel, Moldova*
 - *advanced research – knowledge – new technology – technology transfer*
- ***“Magurele Science Park”***
 - *ELI-NP, TownHall and County Council*
 - *Feasibility Study: hub for R&D activities and high-tech companies*
- ***“Laser Valley – Land of Lights”***
 - *project regional development: science, education, technology, social*



EUROPEAN UNION



Structural Instruments
2014-2020

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Thank you!

www.eli-np.ro