EUROPEAN UNION

GOVERNMENT OF ROMANIA

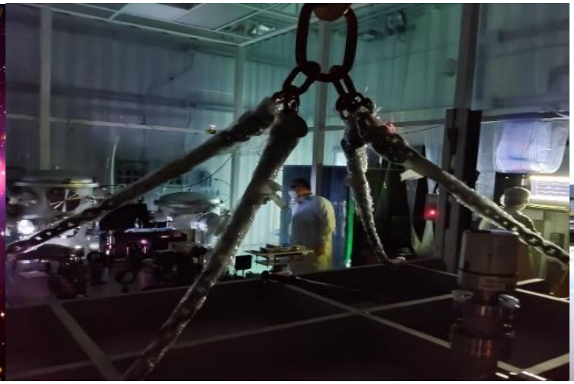
Structural Instruments 2014-2020

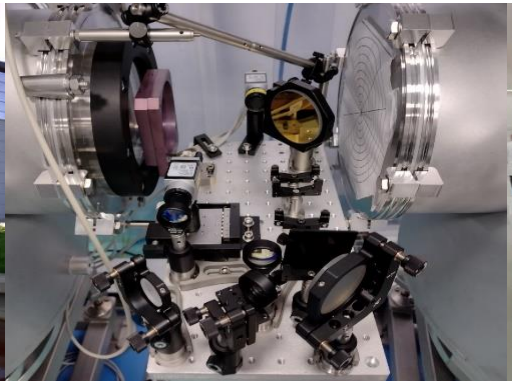
Operational Programme Competitiveness

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

Project co-financed by the European Regional Development Fund

Extreme Light Infrastructure – Nuclear Physics
Nuclear Physics and High Power Lasers




Dr. Ovidiu Tesileanu

on behalf of the ELI-NP team

IMPULSE

IFIN-HH

www.ifin.ro

eli Nuclear Physics

ELI ERIC Polish Information Day

The Henryk Niewodniczański Institute of Nuclear Physics, March 8th, 2023

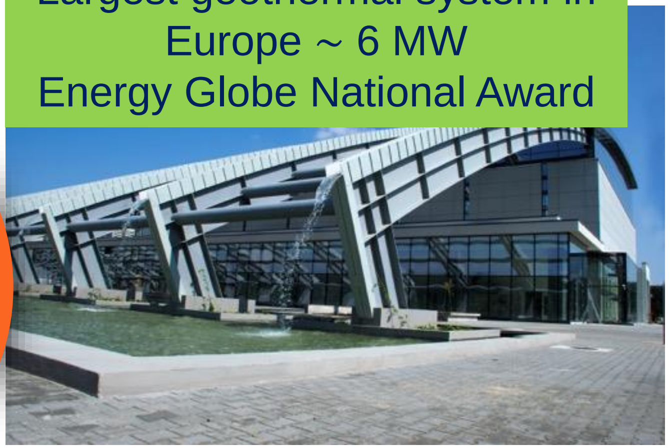
ELI-NP Infrastructure

Operational since 2016

- Experiment building
- Office building
- Guest house
- Caffeteria
- Access control building

Over 32.000 sqm of built area and 270.000 cubic meters of air to condition

Largest geothermal system in Europe ~ 6 MW
Energy Globe National Award

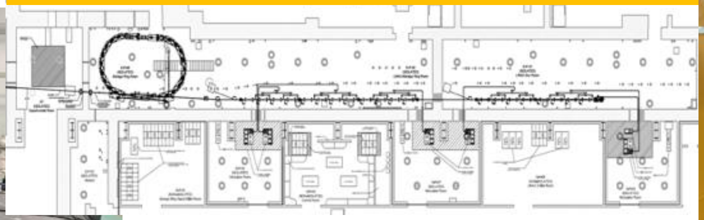


2 x 10 PW High-Power Laser System

120,000 tons antivibration platform

9 Experimental areas

Variable Energy Gamma System



2 x 10 PW + 1 x 1 PW
Laser Beam Transport System

Laboratories and workshops

Clean rooms ISO6 - ISO7

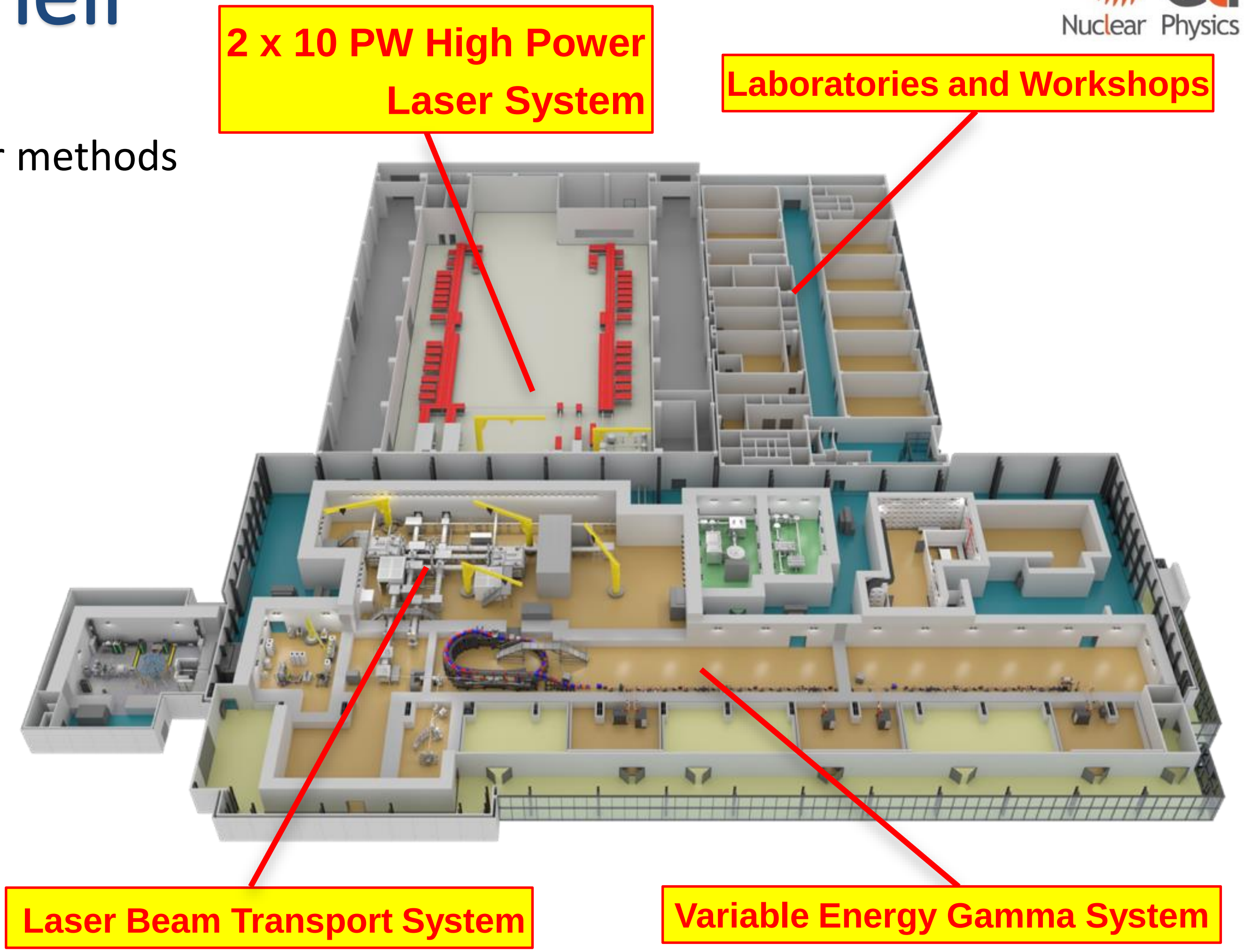
ELI-NP in a nutshell

Advanced studies in basic science ...

- characterization of laser-matter interaction with nuclear methods
- particle acceleration with high power lasers
- nuclear reactions in plasma
- photonuclear reactions, nuclear structure, exotic nuclei
- nuclear astrophysics and nucleosynthesis
- quantum electrodynamics

... and applications – developing technologies for:

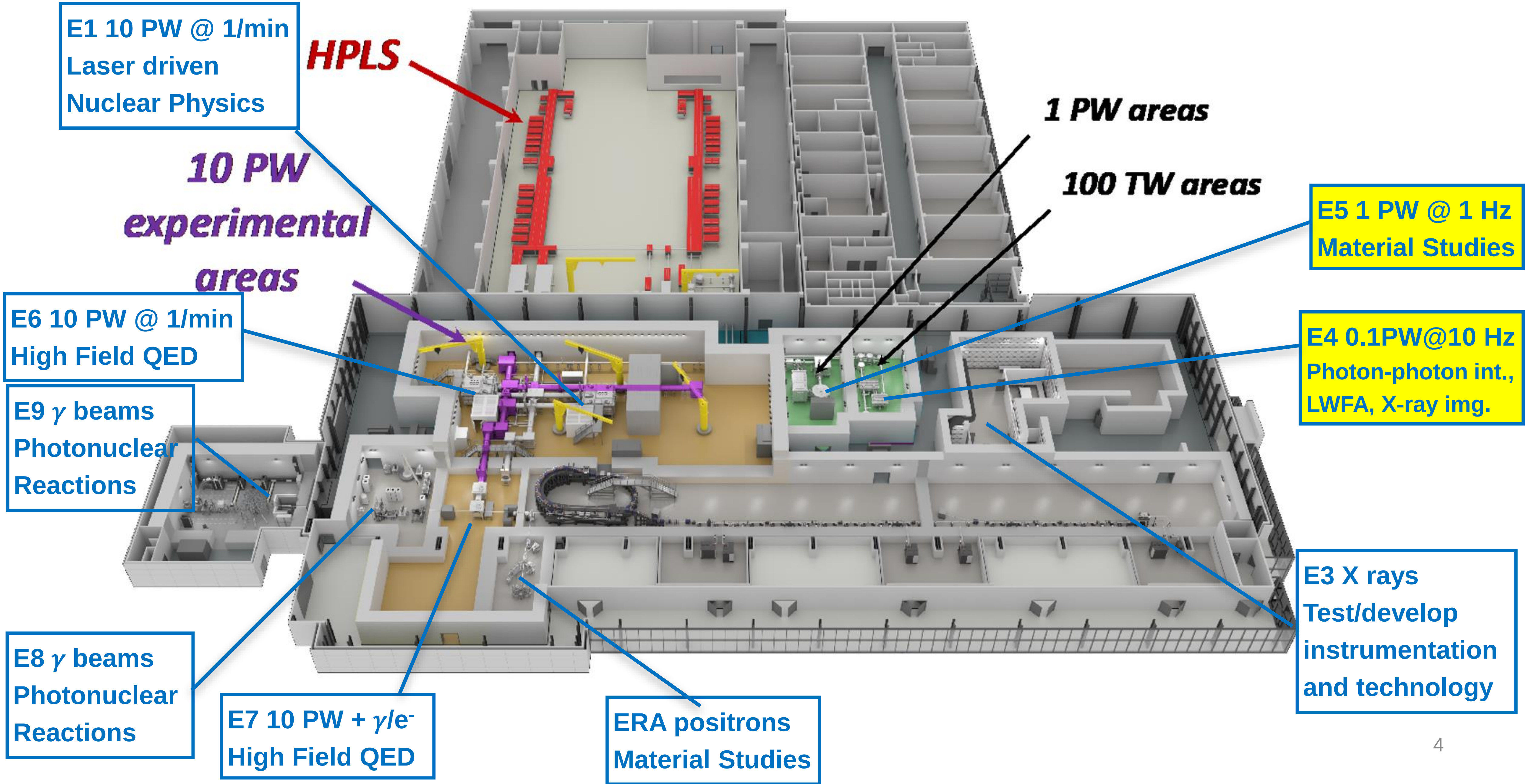
- medical applications (X-ray imaging, hadron therapy, radioisotopes generation)
- industrial applications (non-destructive studies with γ)
- material studies with positrons
- materials in high radiation fields



Our mission

- To produce science at the forefront of knowledge and generate innovation with important benefits for society;
- To attract best users from the international research community and engender a range of excellent scientific results;
- To act as a hotspot for science, innovation and development;
- To inspire younger generations and stimulate education and development.

Layout of the ELI-NP facility



ELI-NP High Power Laser System (HPLS)

<u>Unique system in the world</u>: *power, intensity, number of beams, versatility and flexibility*

- *demonstrated power level 10 PW*
- *combination of 2 high power lasers*

<u>Premiere achievements:</u>

- *large Ti:Sapphire crystals <u>20 cm</u>*
- *large compressor gratings <u>meter size</u>*
- *ATLAS pump lasers <u>100 J</u>*
- *10 PW laser beam transport system*
- *10 PW beam-dump*

Laser Beam Transport System (LBTS) 10 PW

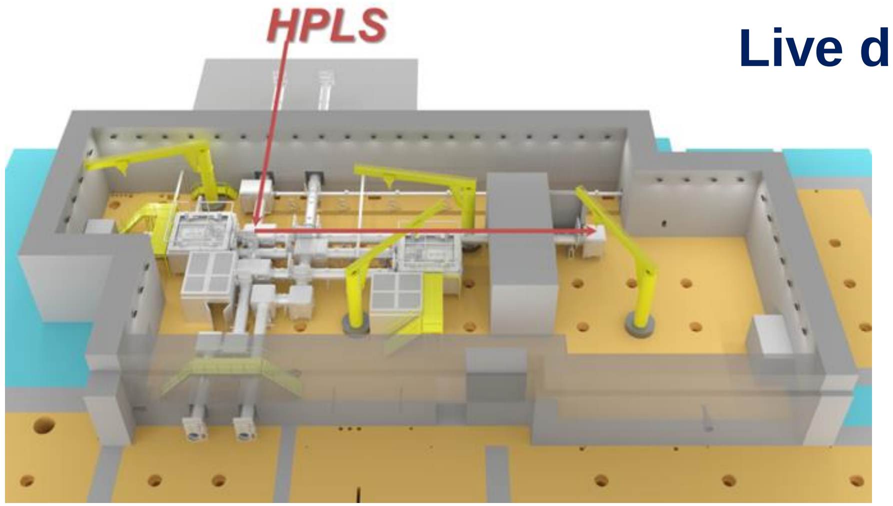
Final acceptance: December 2020

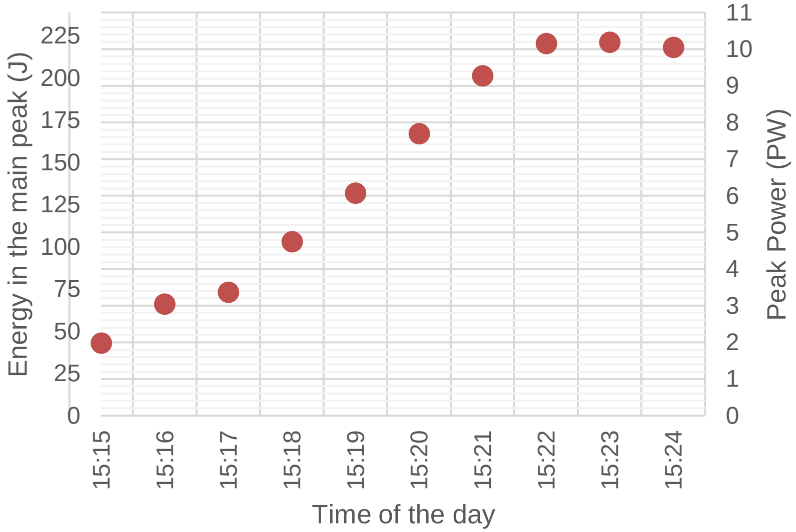
- **2 x 10 PW + 1 PW beams**

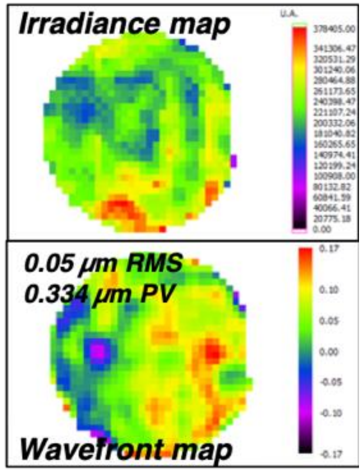
HPLS + LBTS @ 10 PW – November 17, 2020

Inaugural 10 PW and User Symposium – Moving into Uncharted Territories

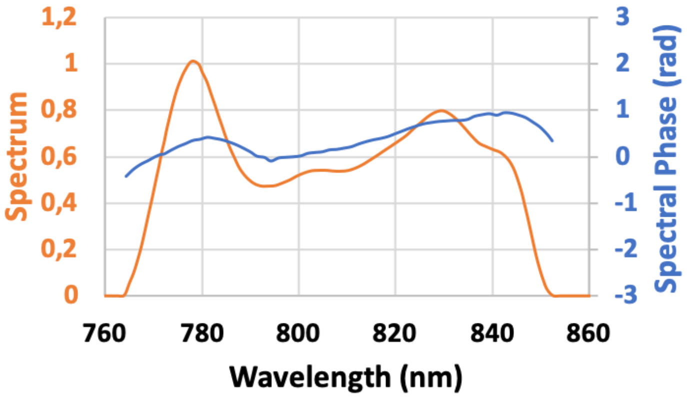
Live demonstration of 10 PW – over 200 participants online



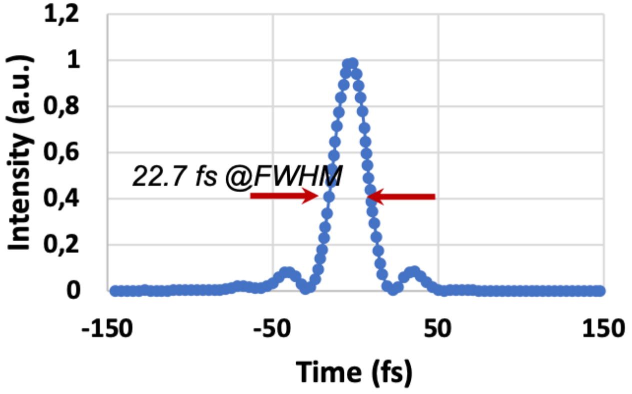




Spatial characteristics

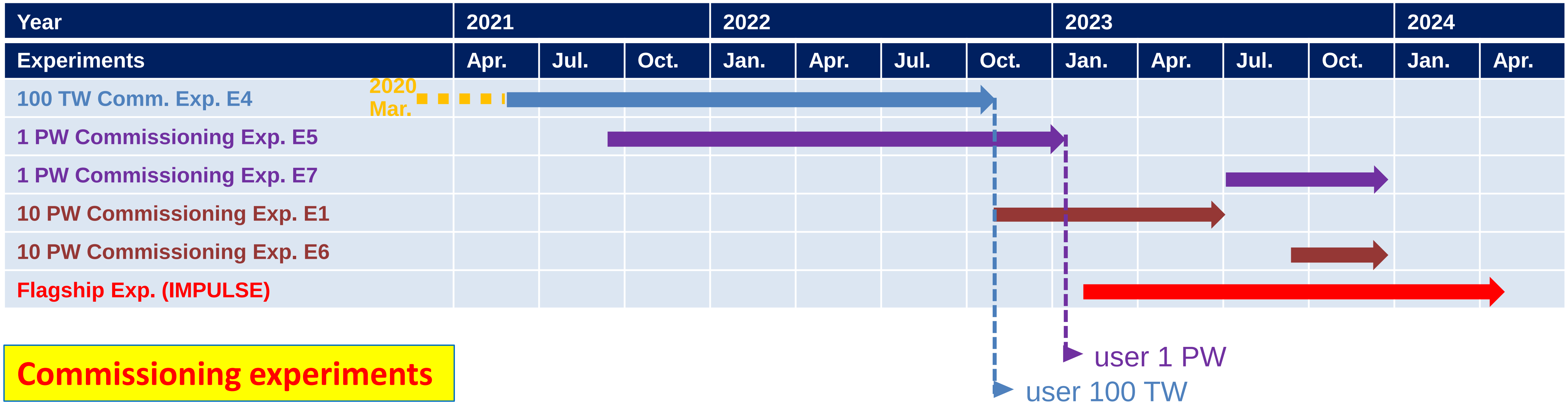


Spectral characteristics



Time characteristics

Implementation ⇒ Operation 2020-2023



Commissioning experiments

100 TW (E4): 2020-2022	Four-wave mixing in vacuum, in search of dark matter candidates X ray production through betatron emission
1 PW (E5 & E7): 2022-2023	Benchmark TNSA proton acceleration Benchmark LWFA electron acceleration Optimization of high charge, stable electron acceleration
10 PW solid target (E1): 2023	Demonstrate extreme focal intensity through laser-γ conversion (“γ-flash”) Demonstrate over 200 MeV proton acceleration (neutron generation add-on) Dense heavy ion beams for nuclear physics
10 PW gas target (E6): 2023	10 PW laser wakefield acceleration of multi GeV electron beams

Studies under Extreme Conditions

Extreme light intensity (10 PW $\Longrightarrow$ 10^{23} W/cm^2)

Extreme electric fields (10^{15} V/m)

Strong-field QED

10 PW laser + solid target

PW γ-source

10 PW laser + GeV LWFA electrons

Radiation reaction
Breit-Wheeler pairs
QED vacuum

Extreme light pressures (Tbar)

Nuclear Physics with Lasers

10 PW radiation pressure acceleration of *dense* ion beams

Nuclear reactions in plasma

Ultra-intense neutron source

Neutron-rich nuclei

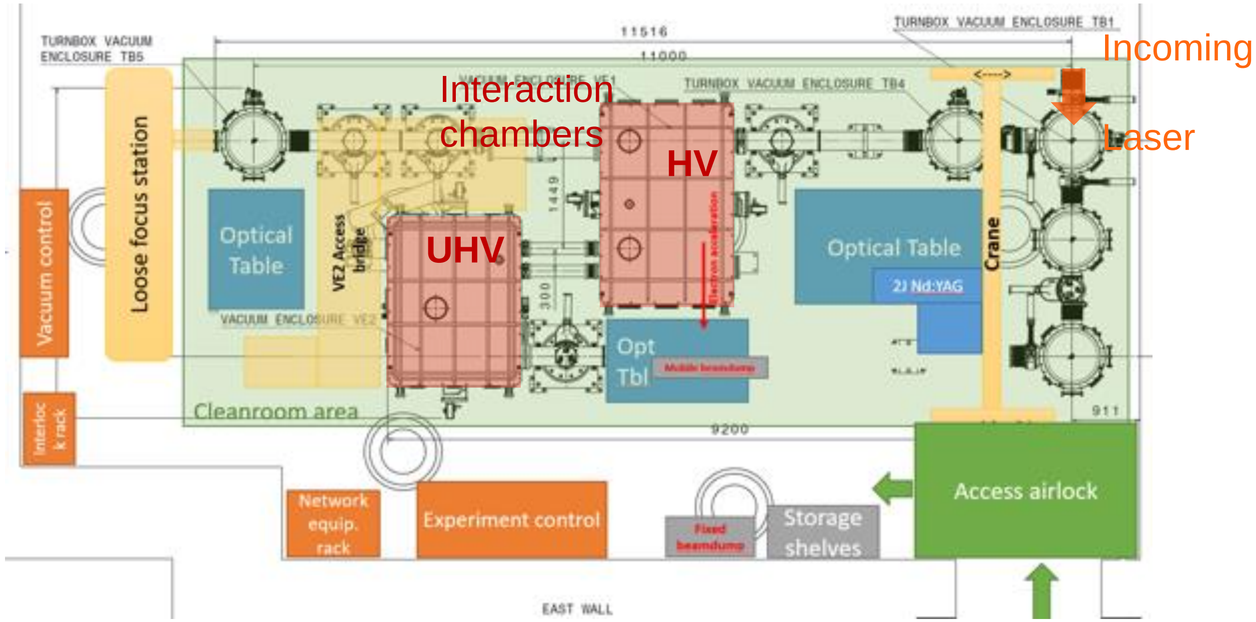
- **Goals of commissioning experiments:**
  - **physics based validation of laser system performance**
  - **develop particle beams for nuclear and QED experiments and applications**

100 TW Experimental area E4

E4: 100 TW

LGED department
(Head of LGED: Ovidiu Tesileanu)

Contact Person: Madalin Rosu
Email: madalin.rosu@eli-np.ro



100 TW area infrastructures

- 2 interaction chambers in stainless steel (**HV – VE1** and **UHV – VE2**)
- 5 turning boxes
- 10 turbomolecular pumps (maglev), 1 cryo-pump
- Integrated control system, automatic / manual modes
- VE1 typical pump time: 60 mins; venting + opening: 45 mins
- Possibility to control the vacuum level up to 10^{-6} mbar
- Large soft-wall cleanroom – equiv. ISO7
- Local Nd:YAG laser: ns pulses, max. 3J at 1064nm, 1.3J at 532nm, 0.9 J at 355 nm

Large Optics available

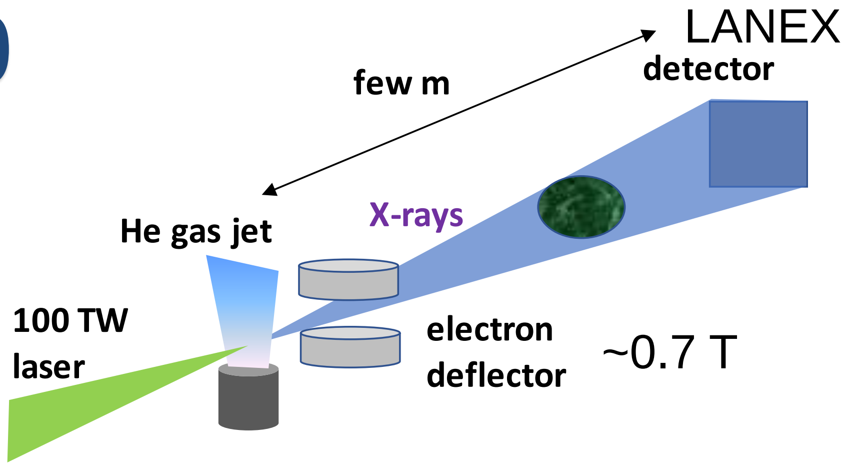
- 6” flat mirrors w/ motorized mounts
- F = 1500mm off-axis parabola, AOI = 6.25°
- F = 520mm off-axis parabola, AOI = 7.5°

Other components for the setup

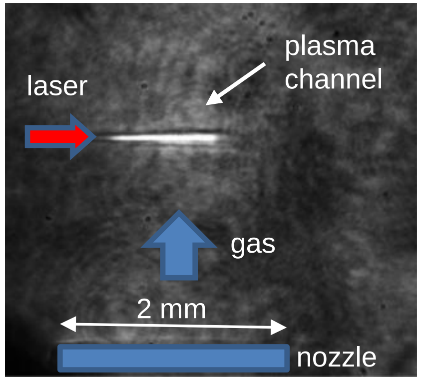
- movement stages and detectors, optical tables, optical diagnostics available on-site

https://users.eli-np.ro/experimental_facilities.php

First Experiments at 100 TW – 2020



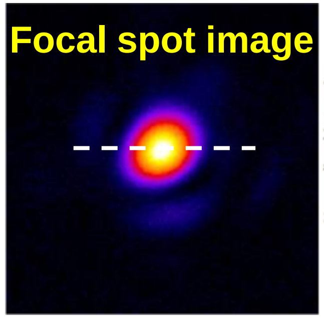
Electron acceleration in gas jet & betatron X-ray emission

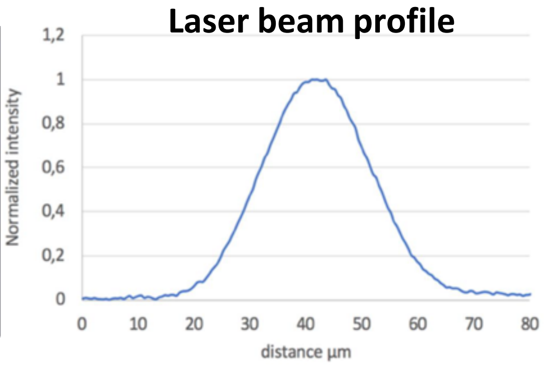


‘Shadowgraphy’
The image of the gas jet at the interaction with the 25 fs laser pulse

Max Energy: < 2.5 J
Pulse duration: ~ 25 fs
Central wavelength ~ 810 nm
Beam diameter: ~ 54 mm
Laser pointing fluctuation: ~ ±7 μrad

Parabolic mirror: 1.5 m focal length (F# ~28)
Spot size diameter: ~ 22±2 μm at FWHM
Encircled energy: ~ 70% @ $1/e^2$





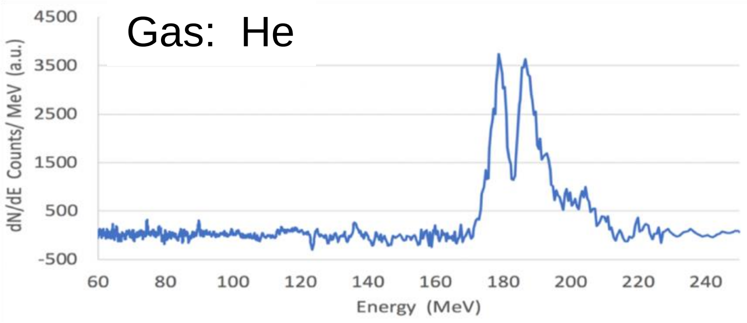
Gas: pure He or He + 2% N_2
Pressure: 10 - 20 bar

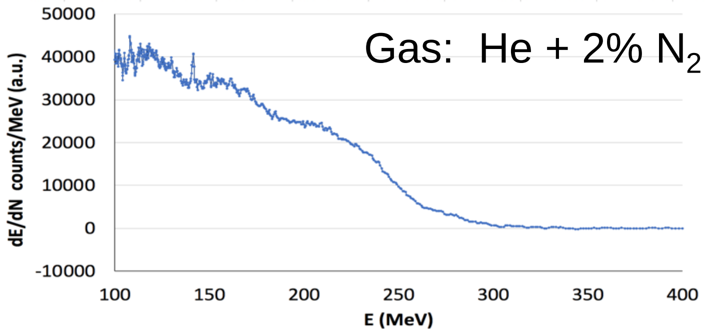
$I_0 \sim 10^{19}$ W/cm^2

LWFA electron acceleration

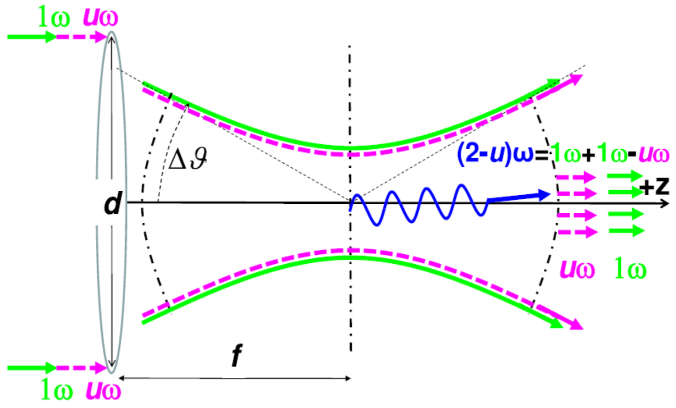
courtesy of D. Doria, P. Ghenuche, M. Cernaianu

→ acceleration field of ~1 GV/cm

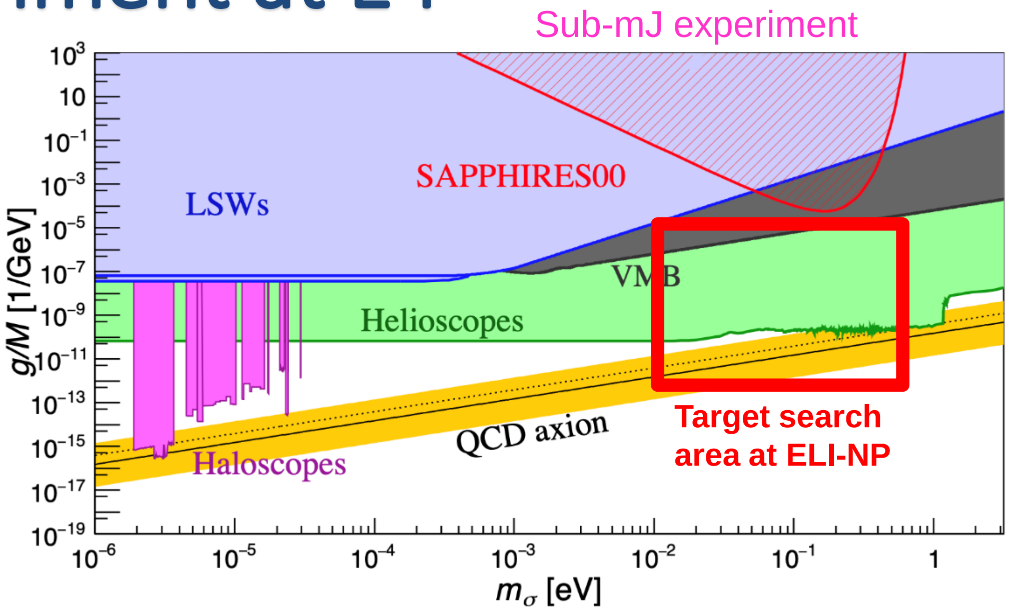




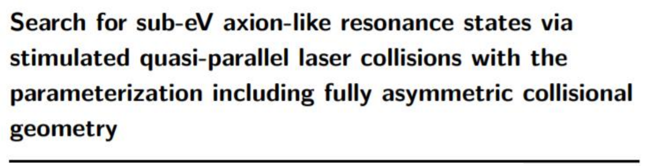
Dark Matter (Axion) Search at ELI-NP
The Commissioning Experiment at E4

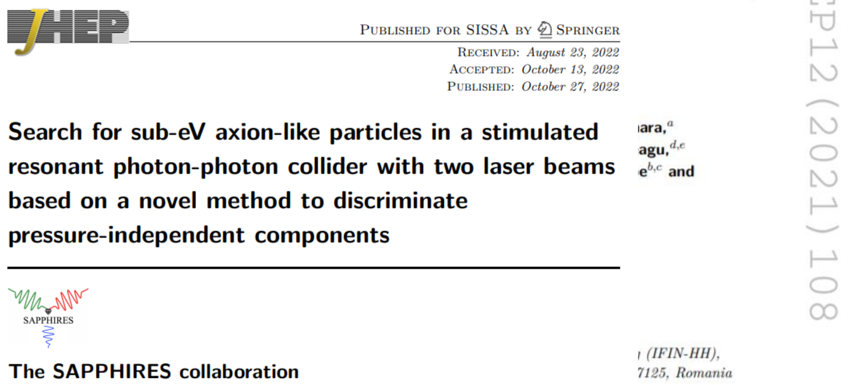


Search for resonance states at very low energies. There are theoretical rationales to expect sub-eV particles.



- Quasi-parallel colliding system (QPS) between two incident photons
- Signature is produced via the four-wave mixing process
- mixing two-color waves with different frequencies 1ω and uω in advance of focus
- **SAPPHIRES** collaboration (Search for Axion-like Particles via optical Parametric effects with High Intensity laseRs in Empty Space):
  - Japan: **K. Homma** (Univ. Hiroshima) & students, S. Tokita (ICR Kyoto)
  - Romania: LGED Experiments group, **local PI Y. Nakamiya**
- **Ongoing data analysis from the commissioning experiments in E4**


Search for sub-eV axion-like resonance states via stimulated quasi-parallel laser collisions with the parameterization including fully asymmetric collisional geometry


JHEP

Published for SISSA by Springer
Received: August 23, 2022
Accepted: October 13, 2022
Published: October 27, 2022

Search for sub-eV axion-like particles in a stimulated resonant photon-photon collider with two laser beams based on a novel method to discriminate pressure-independent components

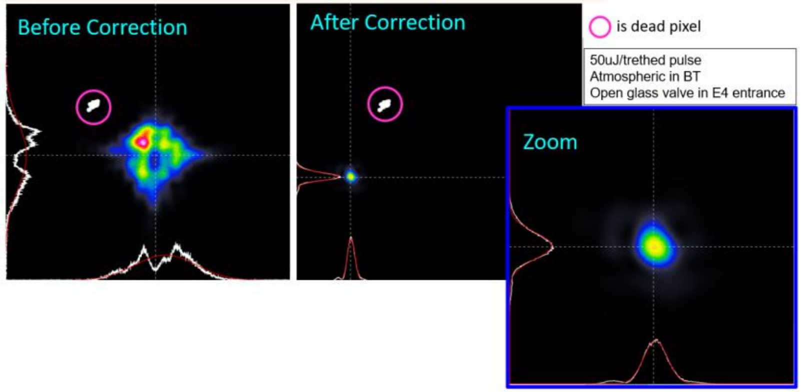
SAPPHIRES

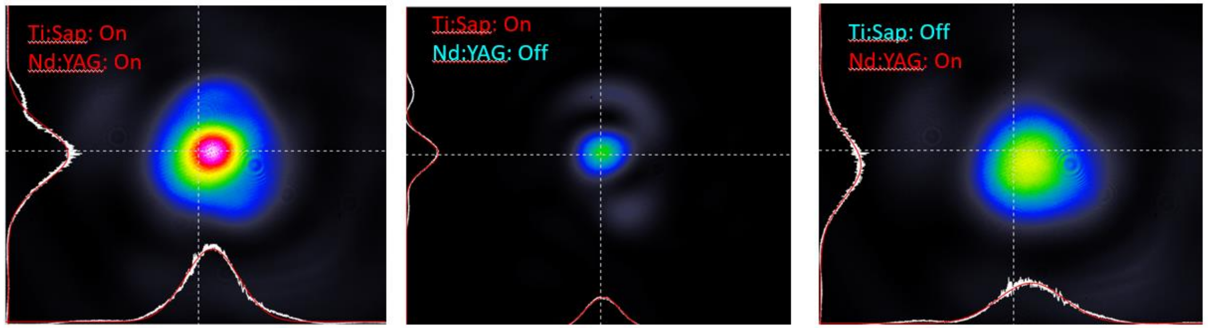
The SAPPHIRES collaboration

JHEP12(2021)108

DM search: Progress and Perspectives

- First beamtime (July-Aug 2021): tuning of the system, first background measurements
- Second beamtime (September-October 2021): 4wm background identified independent of vacuum level – search for ways of mitigation
- Third beamtime (Nov-Dec 2021): two mitigation methods for background implemented and tested with good results
- Fourth beamtime (Mar-Apr 2022): background characterization at 2mJ and 20mJ level, DM search measurements at 20mJ pulses
- Last beamtime (June-July 2022): DM search measurements with 20mJ pulses
- The **SAPPHIRES** collaboration will apply for continuation of the DM search experiments at the 10TW-100TW and then at 1PW areas at improved vacuum (UHV chamber in E4) / increased energy per pulse conditions



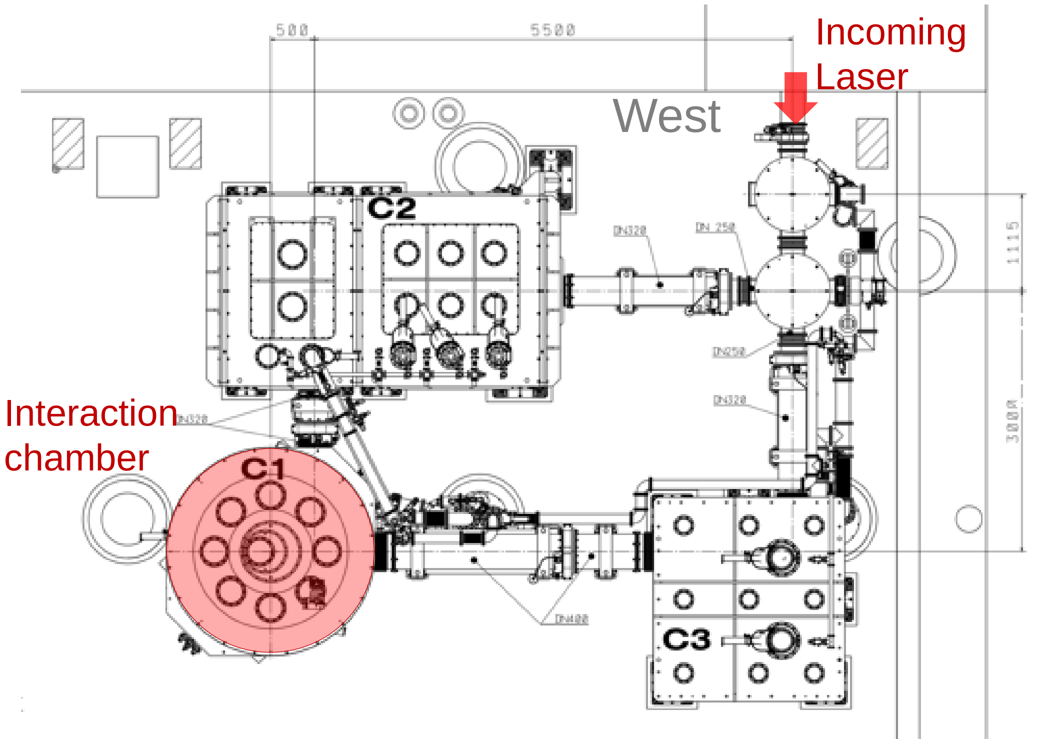


1 PW Experimental Area E5

E5: 1 PW

LDED department
(Head of LDED: Domenico Doria)

Contact Person: Mihail Cernaianu
Email: mihail.cernaianu@eli-np.ro



1 PW area infrastructures

- 1 main interaction chamber (**C1**) in Aluminium
- 2 turning boxes + 2 large chambers (**C2, C3**) in stainless steel
- 9 turbomolecular pumps (1 cryo-pump on demand may be possible)
- Integrated control system, automatic /manual modes
- C1 typical pump time: 90 mins; venting + opening: 60 mins
- Vacuum level up to 10^{-6} mbar
- Small soft-wall cleanroom – equiv. ISO7

Large Optics available

- 12"x8" rectangular flat mirrors w/ motorized mounts
- F = 5000mm off-axis parabola, AOI = 45°
- F = 707mm off-axis parabola, AOI = 22.5°

Other components for the setup

- movement stages and detectors, optical tables, optical diagnostics available on-site

https://users.eli-np.ro/experimental_facilities.php

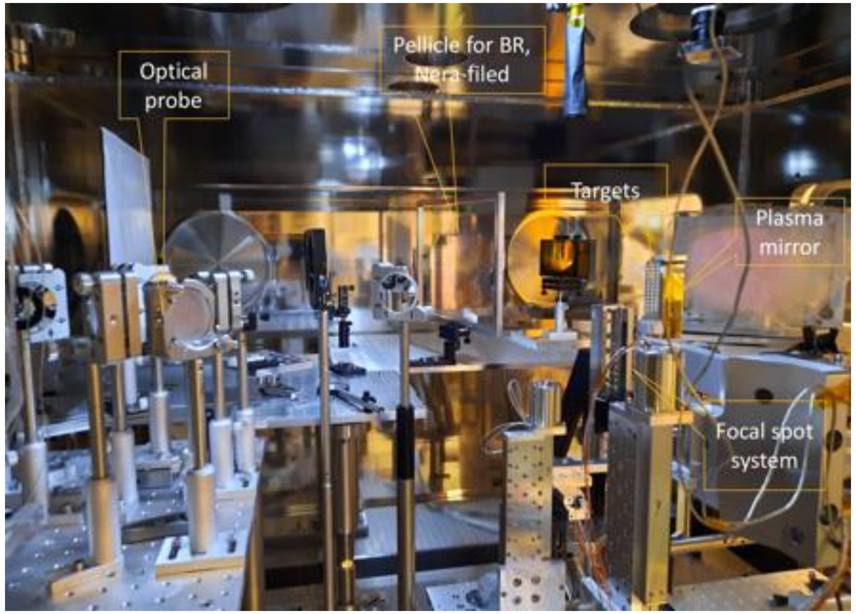
The 1 PW TNSA results

First operation in 2021

Ion acceleration from solid targets (P.I. M. Cernaianu)

- **Thick** and **thin foils** (e.g. Al, CH, DLC)
- F=710mm parabola
- **Max. proton energy** attained of **50 MeV** with SPM
- **Max. ion energy** attained: carbon ion **15 MeV/n** from DLC target with SPM

Experimental setup

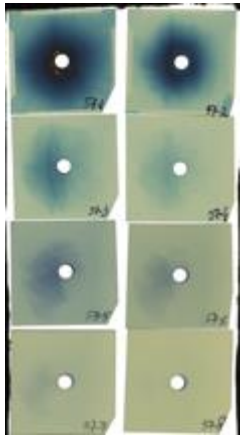


Shot parameters with plasma mirror

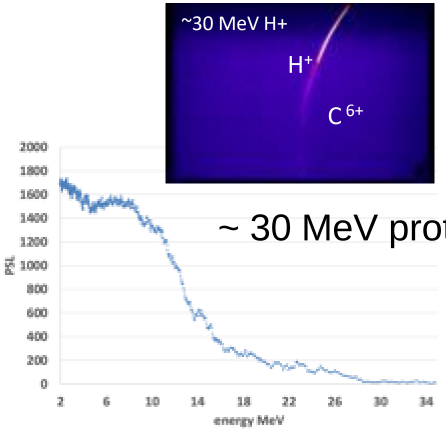
Laser beam power: 23.1 J, ~26 fs ➔ 880 TW
Intensity on target: ~ 4 x10^{21} W/cm^2
Target: 1.5 µm Al foil

Laser beam power: 19 J, ~75 fs ➔ 250 TW
Intensity on target: ~ 1 x10^{21} W/cm^2
Target: 380nm DLC (built in house)

Radiochromic film stack

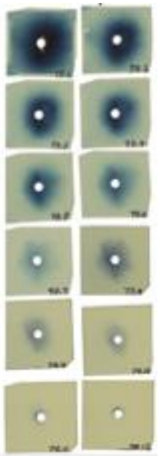


Thomson parabola data

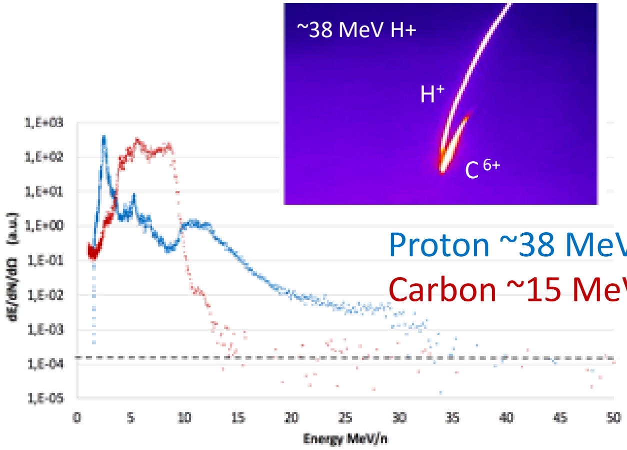


~ 30 MeV proton

Radiochromic film stack

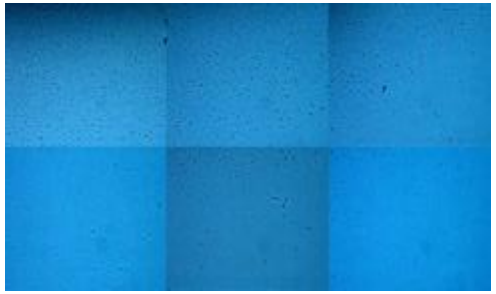


Thomson parabola



Proton ~38 MeV
Carbon ~15 MeV/n

CR-39 show E_p > 50 MeV



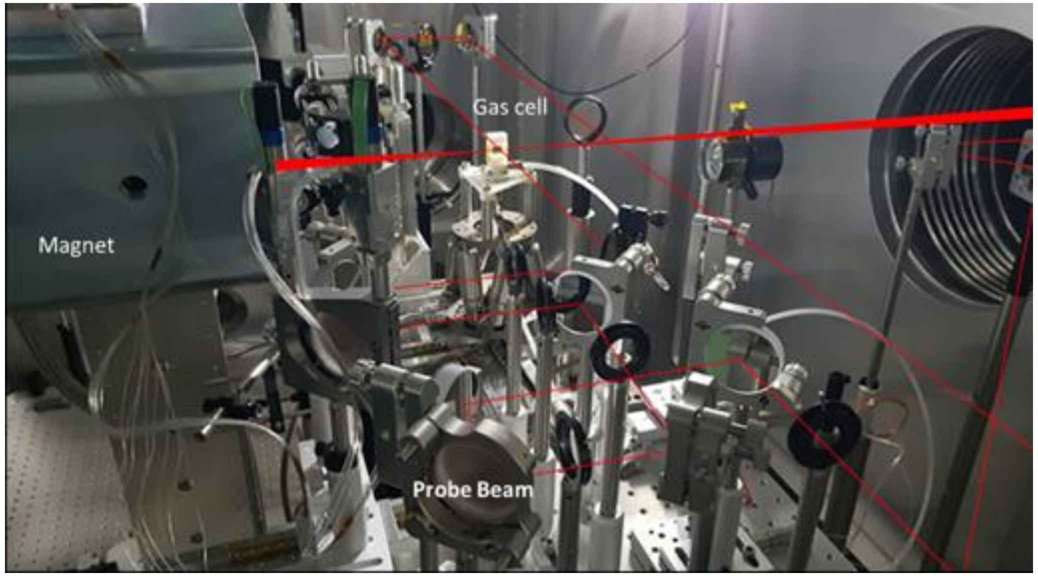
Proton density ~ 10^3 protons /cm^2

The 1 PW LWFA results

First operation in 2021
Electron acceleration in gas targets (P.I. P. Ghenuche)

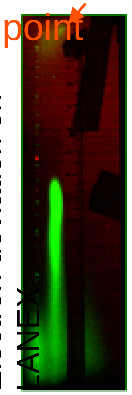
- **Gas jet target** and **gas cell** from **2mm to 2 cm long**
- SourceLab variable metal gas cell, fix 3D printed gas cell, 2 mm metal gas jet
- **Pure He** and admixture **He +2% N_2** were used
- F=5000mm parabola
- Max. electron energy obtained with both **Helium gas and admixture of ≈ 2 GeV**
- **Electron diagnostics**: spectrometer (up to 3 GeV) – 30 cm long dipole magnet with 3 cm gap and ~1 T B-field, and a Lanex screen

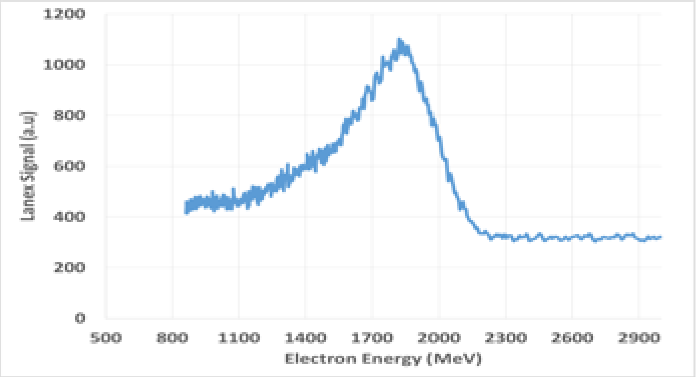
Experimental setup



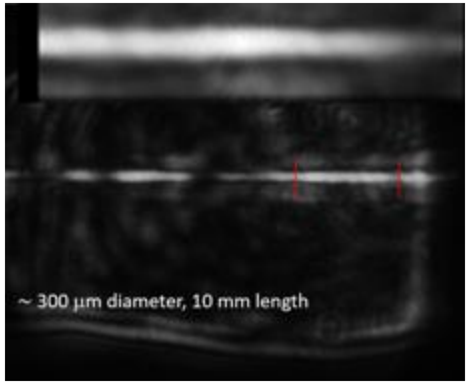
zero point

Electron deviation on LANEX

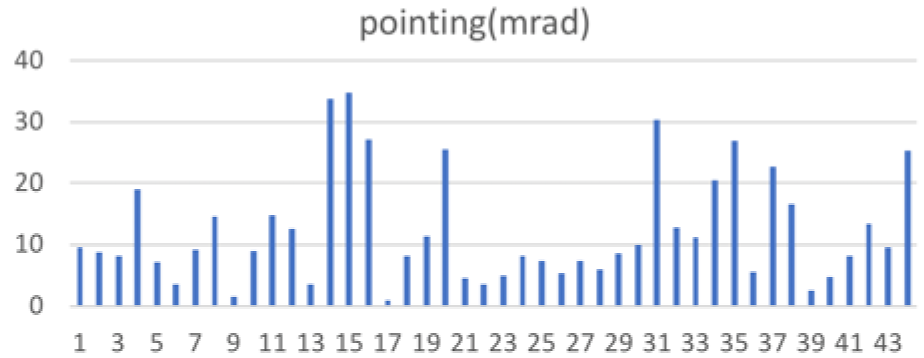




Electron Beam Energy Spectra for pure He

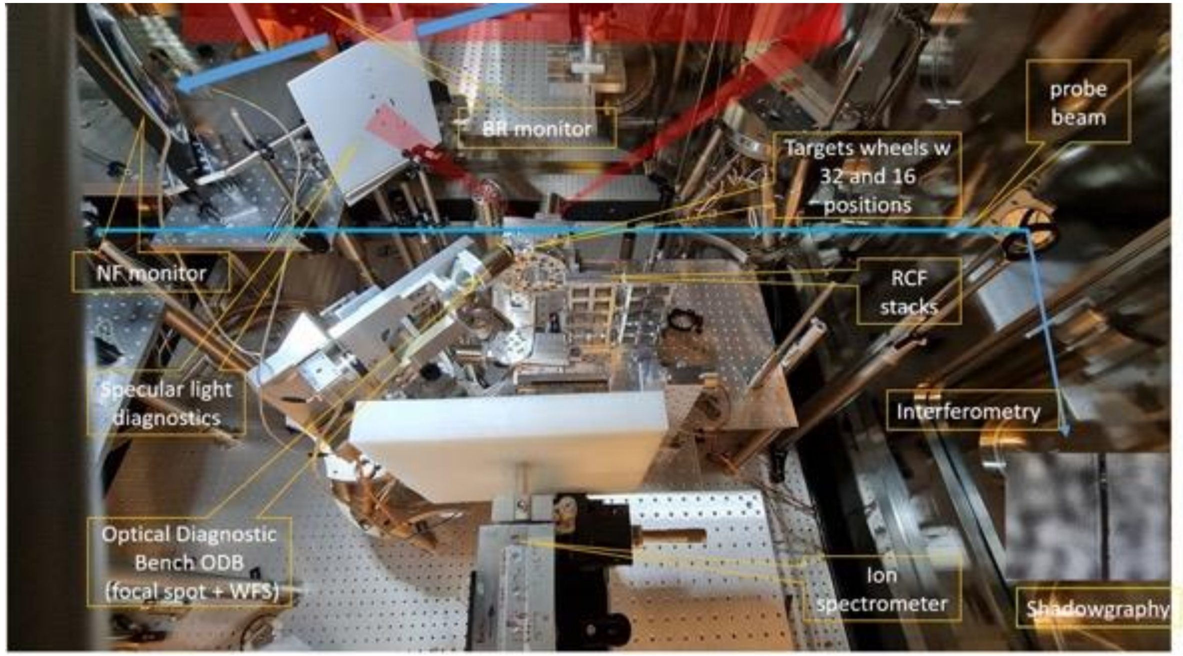


Shadowgraphy and WFS (plasma channel)



Electron Beam Pointing in a typical day from gas admixture

1 PW Solid target experiment diagnostics



Main diagnostics:

- 16 RCF stacks
- TP Ion spectrometer: online LANEX readout or IP plates.
- Laser specular and back reflection energy measurement
- Specular and back reflected laser spectrum
- Laser near field (full aperture), Far field, Energy, Spectrum (pick-up) on-shot
- Plasma probing: Shadowgraphy, Interferometry
- Pulse duration (Laser bay and Experimental area)
- Temporal Contrast measurement

Multi – Target system:

32 targets loaded for a day of shooting

Microscope objective for target alignment and focal spot optimization

1 µm alignment precision

Al target foils mounted on holder

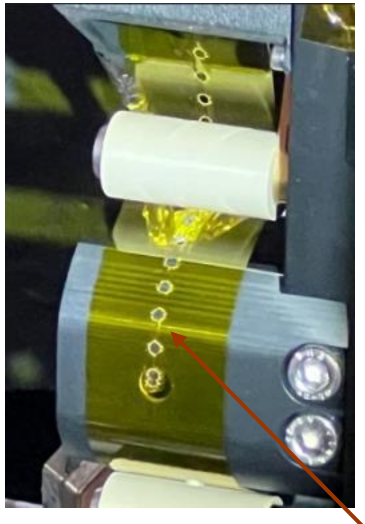
Before shot

After shot - exploded

1 PW Commissioning @1 Hz repetition rate using a tape target (E5)

TNSA experiment at high repetition rate

Tape target system developed by RAL UKRI within the H2020 IMPULSE project tested at ELI-NP in collaboration with ELI Beamlines and STFC

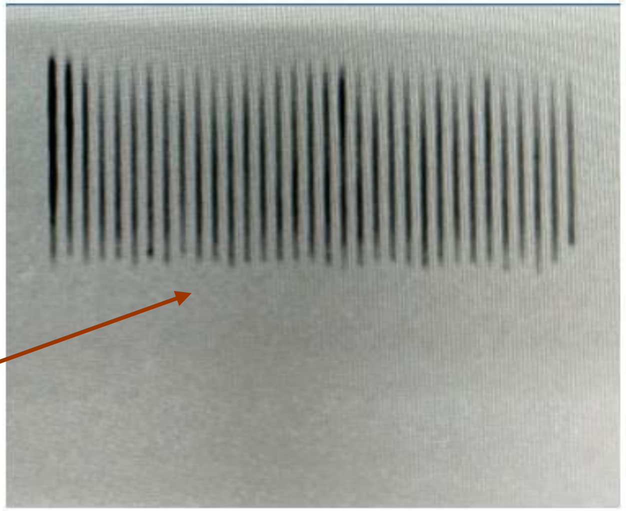


13 μm thick Kapton ribbon running at 11 mm/s

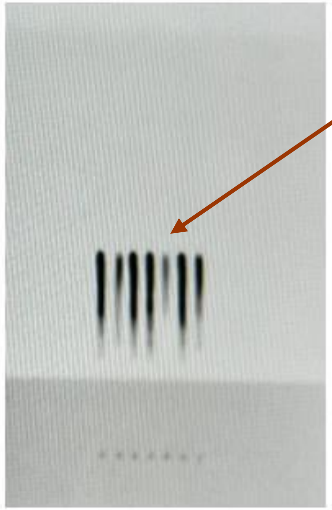
Laser beam produced hole

proton cut-off energy of about 7 MeV with a shot-to-shot energy variation of ±5%

Image Plate



proton traces of 33 consecutive shots at 2 J laser energy delivered at 1 Hz



proton traces of 7 consecutive shots at 20 J delivered at 1 Hz

proton cut-off energy of about 25 MeV with a shot-to-shot energy variation of ±10%

Courtesy of Domenico Doria and Mihail Cernaianu

Commissioning of 10 PW experiments in E1 and E6

LBTS

E1

Long focal mirror

Overview

E6

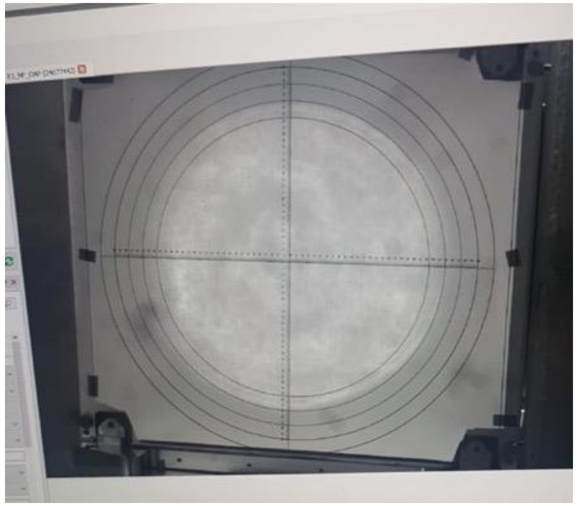
Large Optics

- 30 m focal spherical mirror
- 1.5 m short focal off-axis parabolas

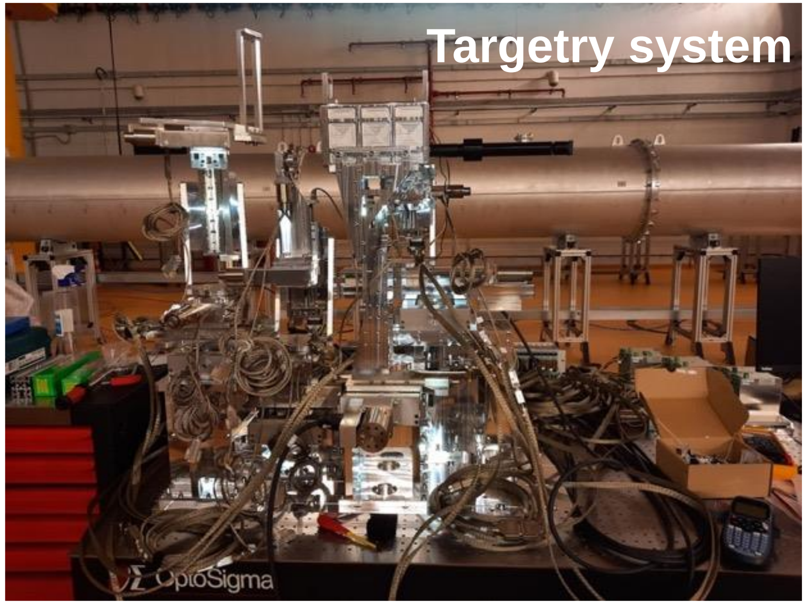
The installation of the short focal mirror in E1 area is done along with full diagnostic benches

Preparation of 10 PW E1 interaction chamber

Near-Field on parabola

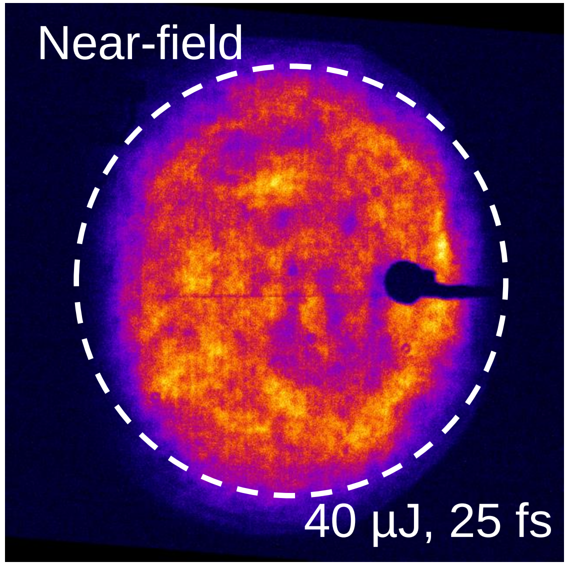


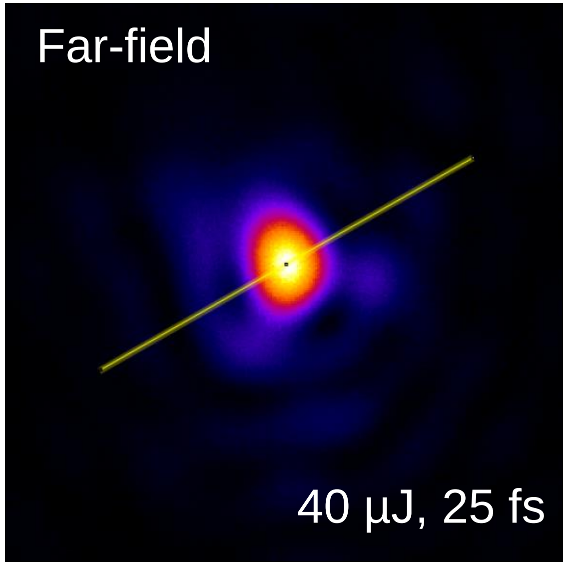
E1 chamber: short focal mirror



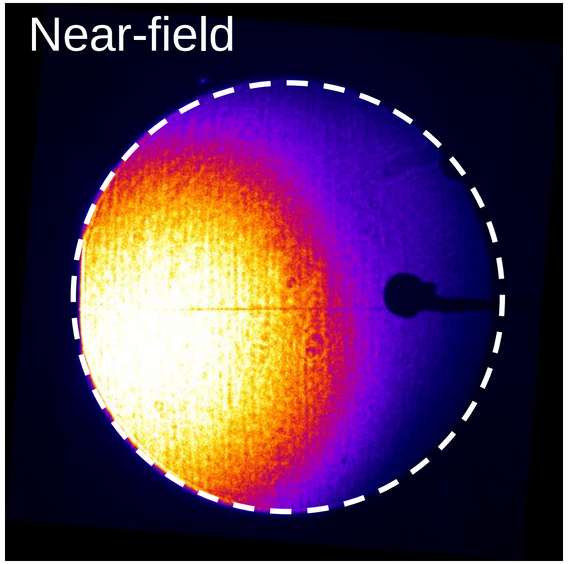
Preparation of 10 PW E1 interaction chamber

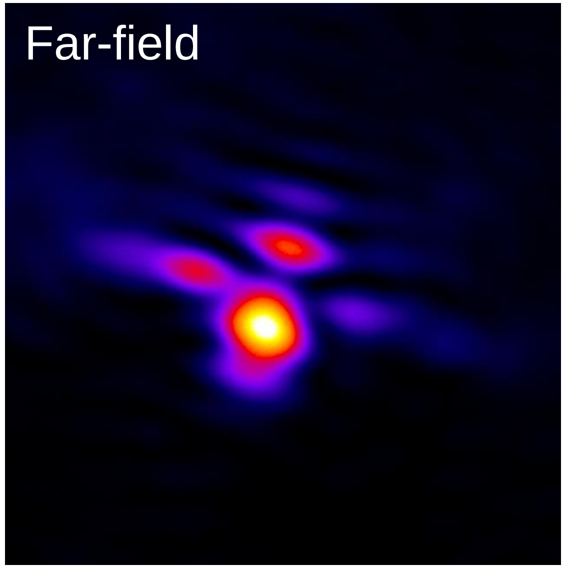
HPLS



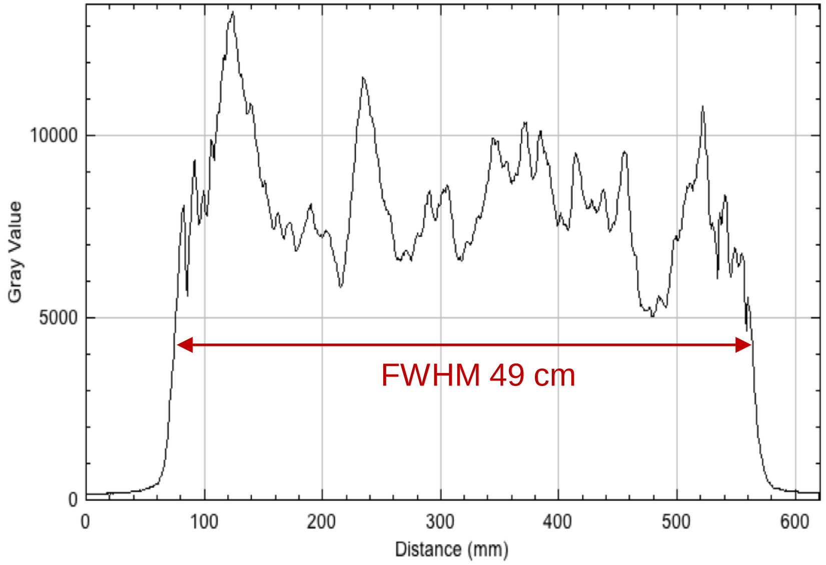


FAL, CW 810nm 200 mJ

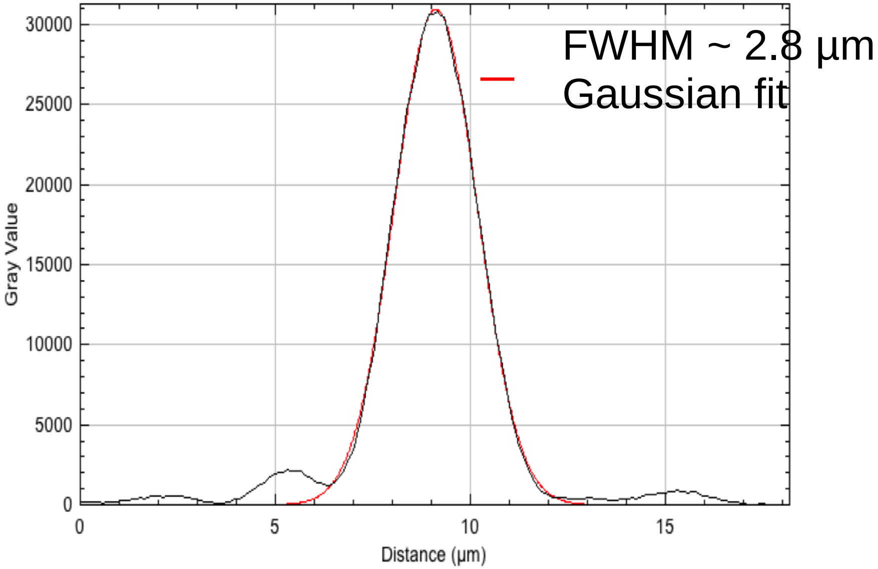




HPLS Near-field profile



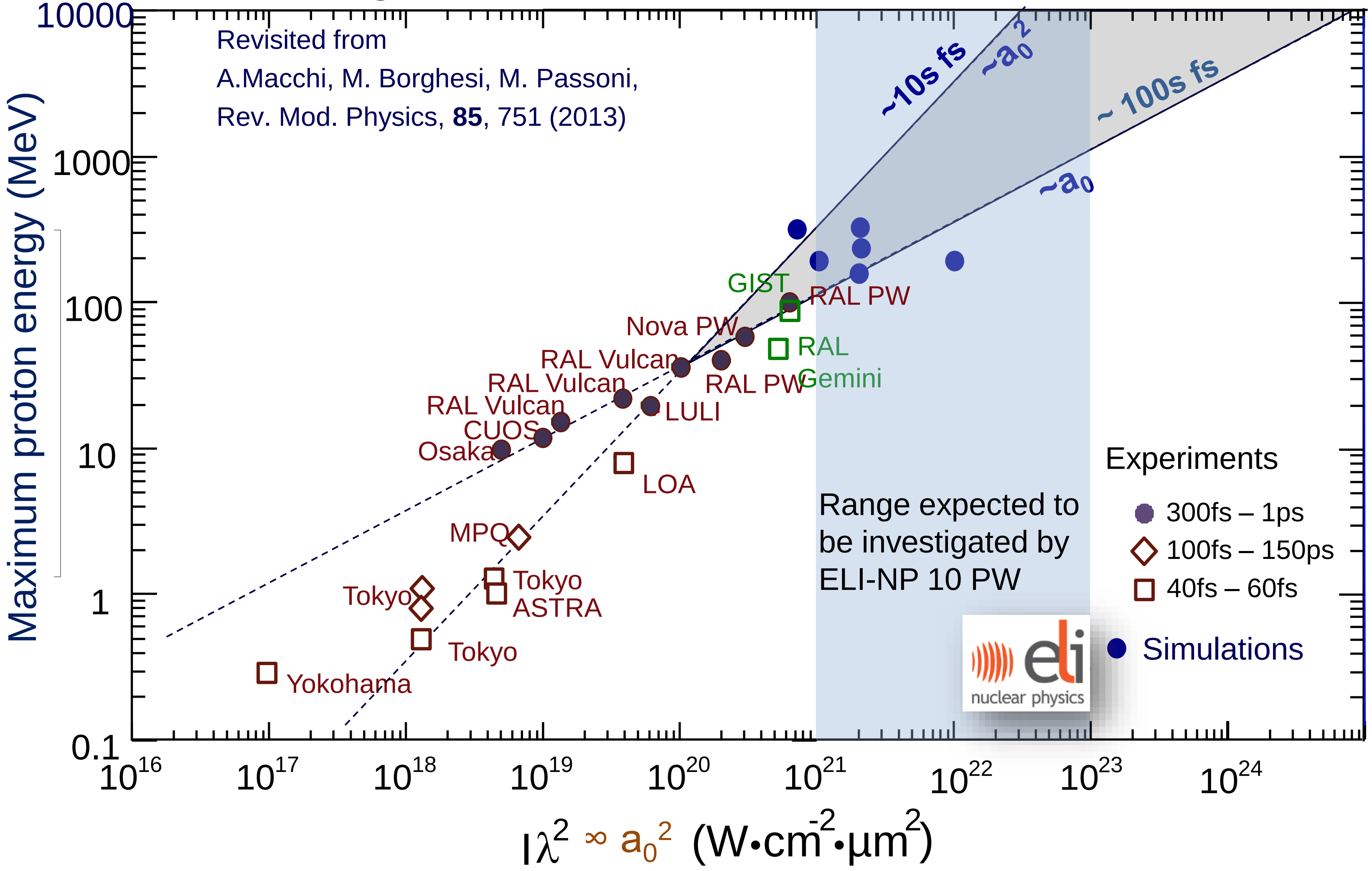
HPLS Far-field profile



First Experiments at 10 PW – 2023

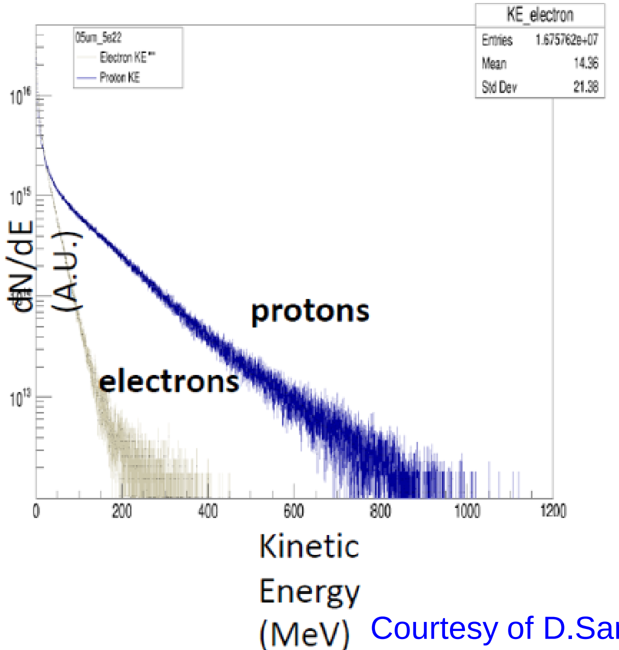
TNSA regime : accelerating protons above 200 MeV expected by ISAB (theory ⇨ sub-GeV proton and 100s MeV/u light ions)

TNSA scaling law and state-of –the-art



Computed particle spectra at $I=5x10^{22}$ W/cm² at ELI-NP

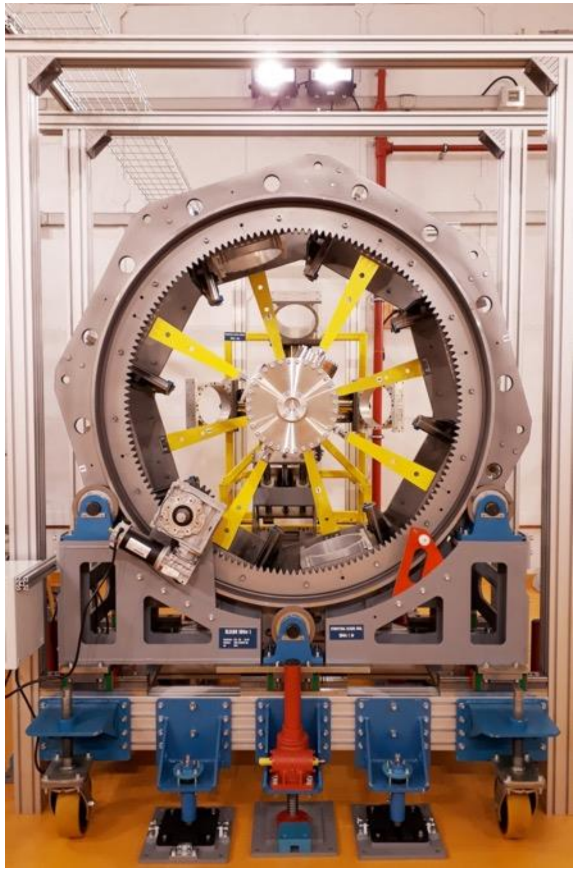
0.5 µm CH



Courtesy of D.Sangwan

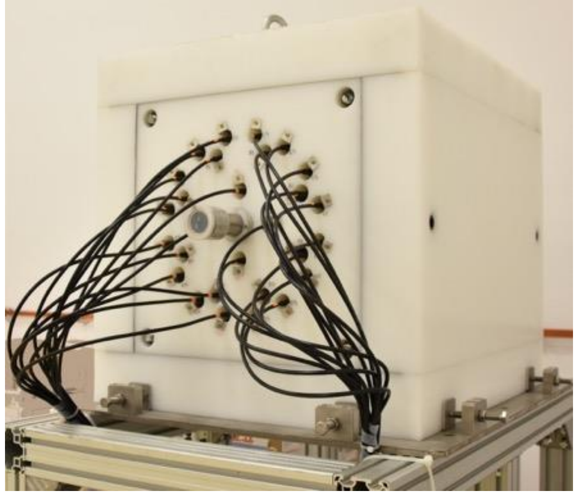
ELI-NP Gamma Beam Experiments: Implementation status

ELIADE



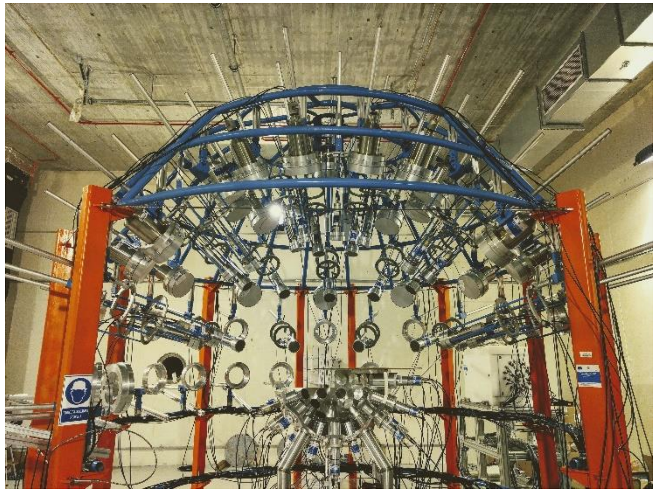
Installed in E8 experimental area
Ready for use – end of 2019

ELIGANT-TN



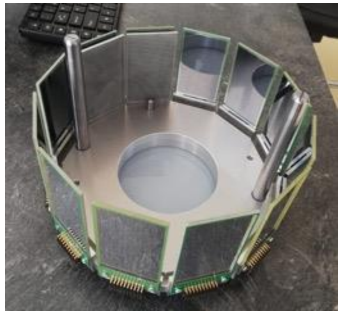
Installed in LP51 laboratory
Ready for use

ELIGANT-GN



Installed in E9 experimental area
Ready for use – end of 2019

ELISSA

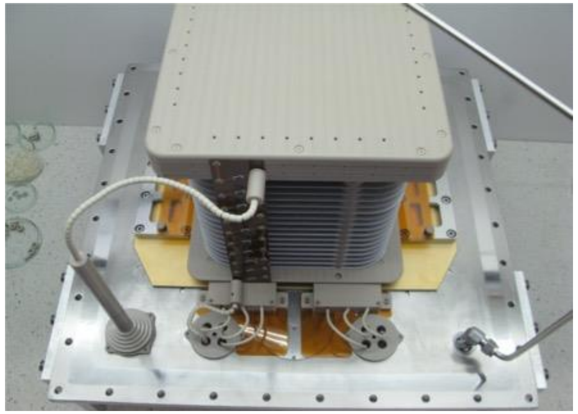


Installed in LP51 laboratory
Ready for use – end of 2019

Physics Case:

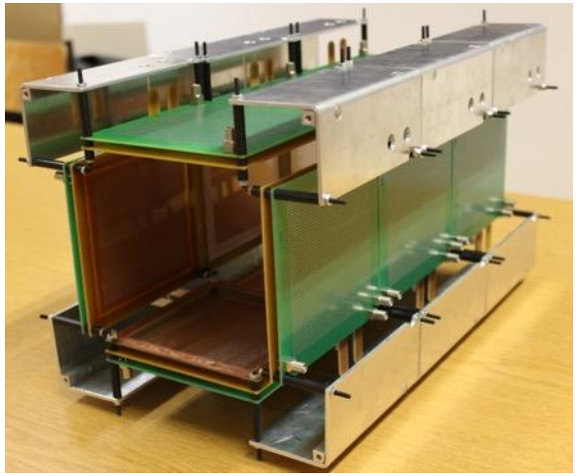
- **Nuclear Physics**
  - Nuclear structure
  - Dipole response of nuclei
  - Pygmy and Giant Dipole Resonances
  - Photonuclear reactions cross sections
  - Nuclear astrophysics
  - Photofission and exotic nuclei
- **Applications**
  - Industrial and medical imaging
  - Medical Radioisotopes
  - Material studies with positrons

ELI-NP Gamma Beam Experiments
Implementation status



mini eTPC

Installed in LP51 laboratory
Built with U.Warsaw
Ready for use



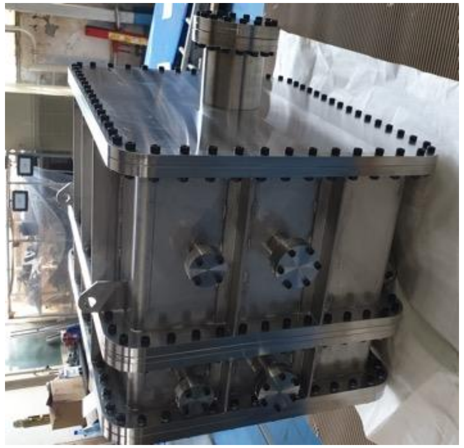
ELITHGEM

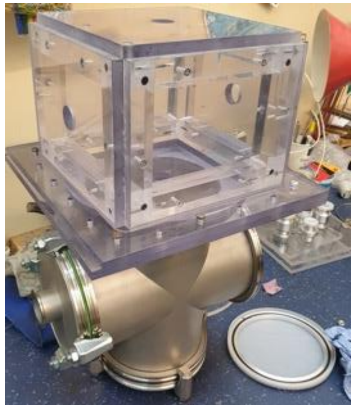
Under tests at ELI-NP
Design ATOMKI, Debrecen
Ready for use – 2023 Q4

ELIBIC

Under tests at ELI-NP
Design ATOMKI, Debrecen
Ready for use – 2023 Q4

ELI IGISOL

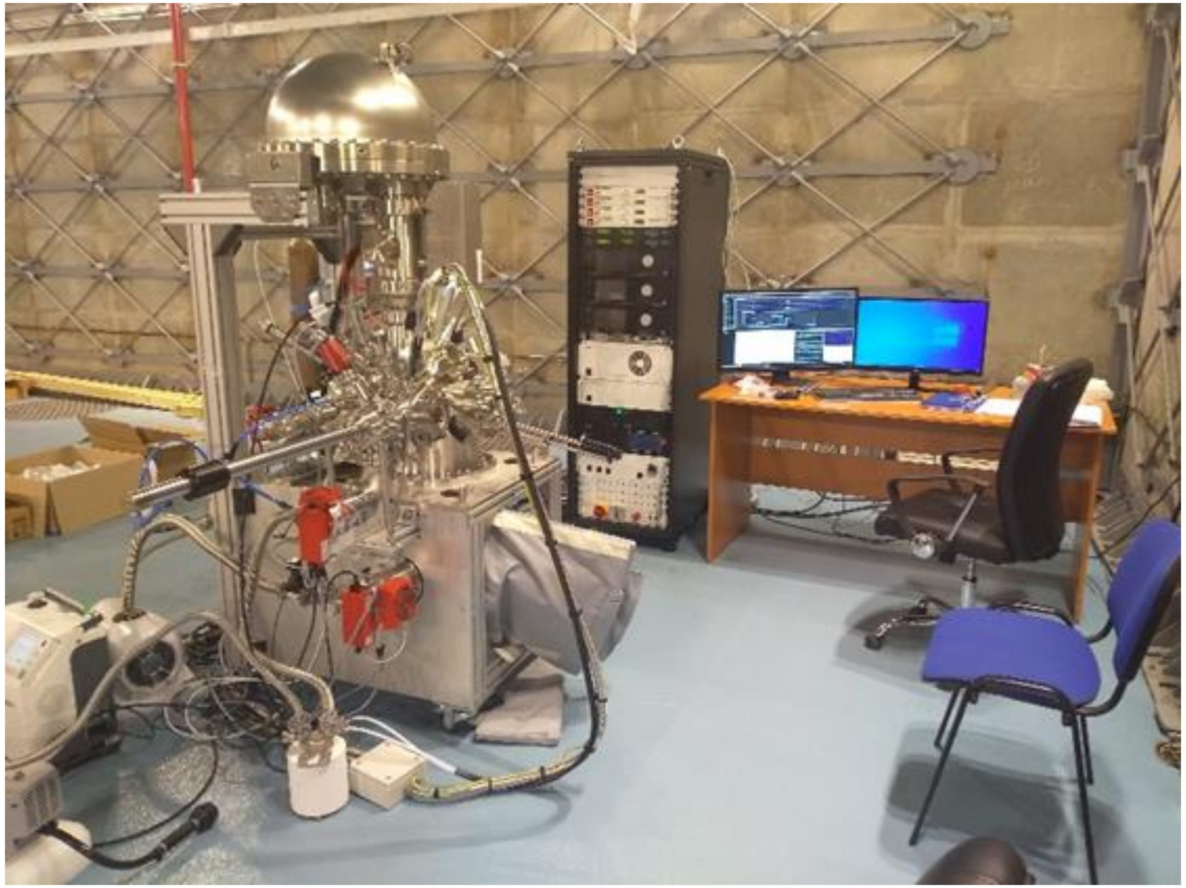




Under development
Development with GSI
Prototype design – 2023

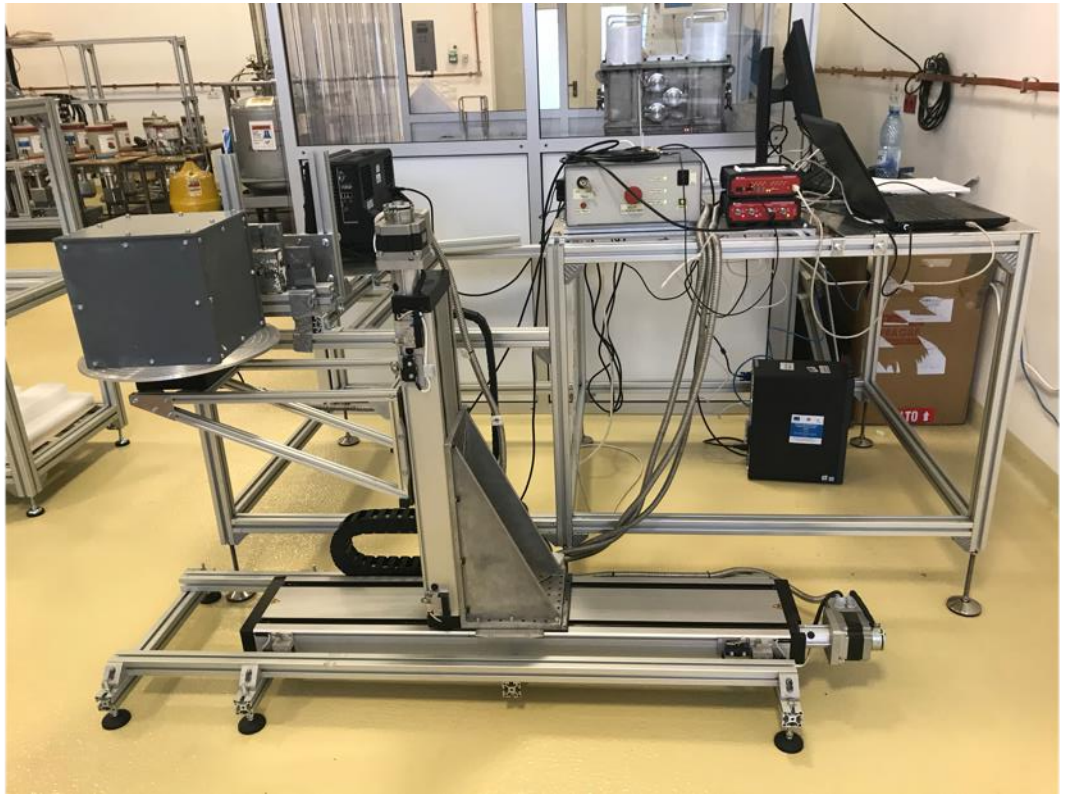
ELI-NP Gamma Beam Experiments
Implementation status

PAES



Installed in ERA experimental area
Sigma Surface Science Germany
Ready for use

CT and Radiography Applications



Installed in LP51 laboratory
Motionlink Ltd. UK
Ready for use – 2020 Q3

Collaboration with Polish groups within the gamma-beam research

University of Warsaw (Prof. W. Dominik) *– see presentation in afternoon session*

- The collaboration was established with the start of the project
- The Univ. Warsaw team participated in the preparation of the TDR on charged-particle detection
- Joint project to design and construct the the mini-TPC detector for ELI-NP
- Design and construction of the ELITPC as in-kind contribution
- Nuclear astrophysics experiments at HIγS, Duke Univ. with the full scale prototype of the ELITPC

Romanian Reports in Physics, Vol. 68, Supplement, P. S699–S734, 2016

CHARGED PARTICLE DETECTION AT ELI–NP

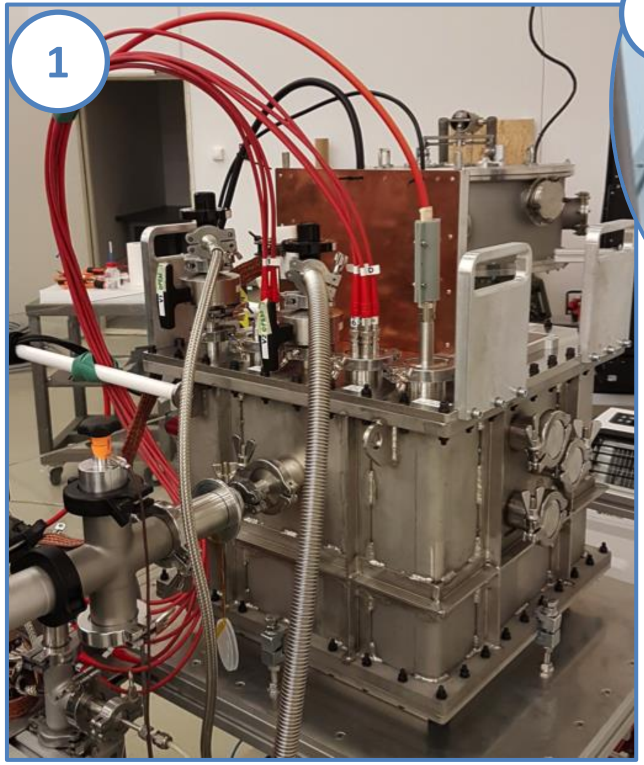
O. TESILEANU[1*], M. GAI[2,3], A. ANZALONE[4], C. BALAN[1], J.S. BIHALOWICZ[5], M. CWIOK[5], W. DOMINIK[5], S. GALES[1], D.G. GHIŢĂ[1,6], Z. JANAS[5], D.P. KENDELLEN[7,3], M. LA COGNATA[4], C. MATEI[1], K. MIKSZUTA[5], C. PETCU[1], M. PFÜTZNER[5], T. MATULEWICZ[5], C. MAZZOCCHI[5], C. SPITALERI[4]

IFJ PAN (Prof. A. Maj) *– see presentation in afternoon session*

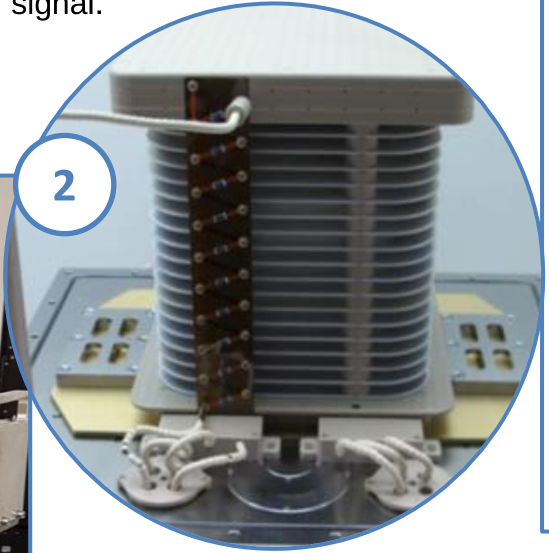
- Long-standing collaboration in studies of large-amplitude motion in atomic nuclei
- Joint participation in experiments in different laboratories
- The IFJ team took part in the first in-beam tests of the ELIGANT-TN detector

Joint project with University of Warsaw: The ELI-NP Time Projection Chamber

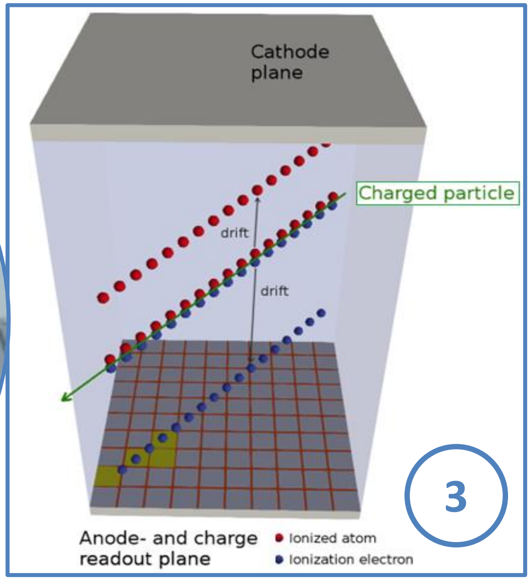
1. The ELI Time Projection Chamber (ELITPC) is a gaseous detector in which the gas acts at the same time as a target for the nuclear reaction and detection medium. It can be used to digitally reconstruct trajectories of particles as they translate through the active volume.



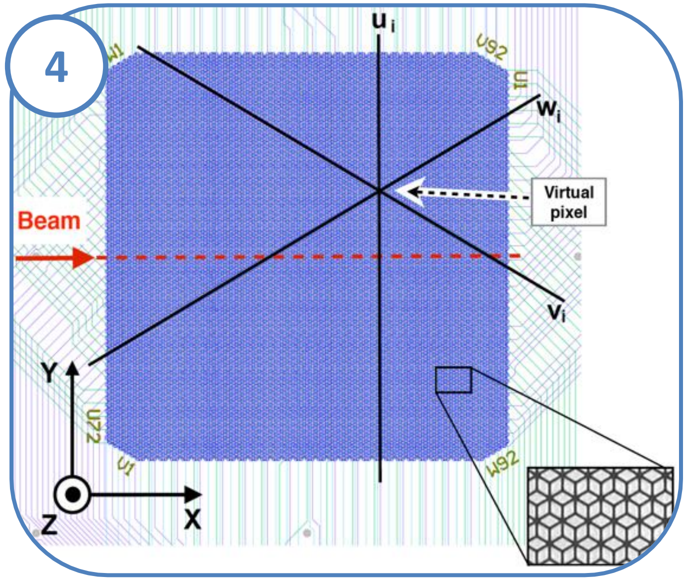
2. The active volume is 1000 cm^3 and and uses 3 Gas Electron Multipliers to amplify the electron signal.

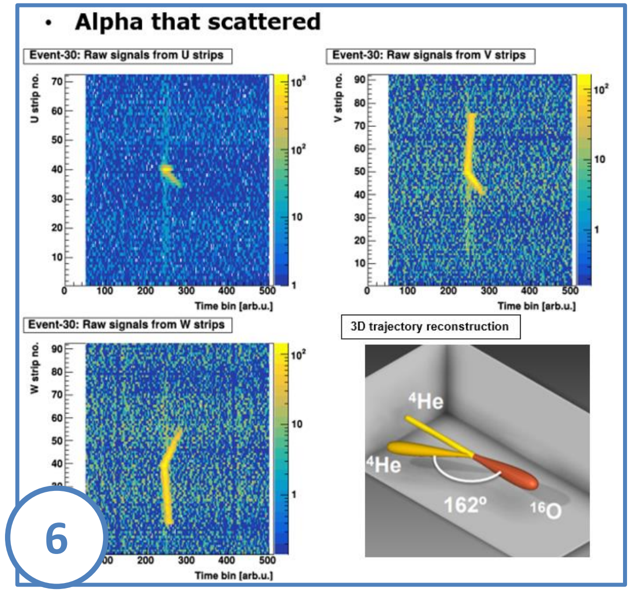


3. Vertical reconstruction is done by adjusting electron drift speed.

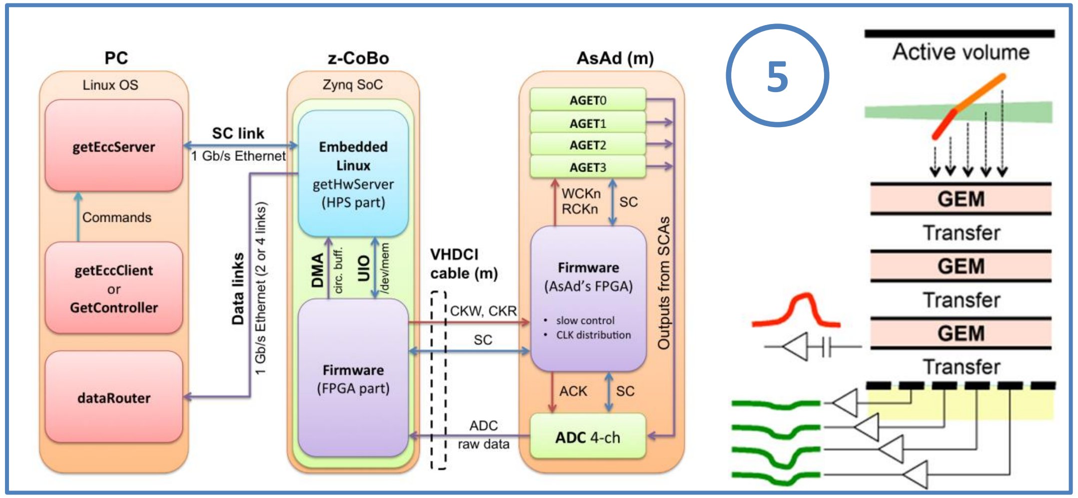


4. The read-out anode is segmented into 3 planes, U-V-W with each plane having 72 channels.





6. The information of each event for the U-V-W data is reconstructed into a 3D kinematic reconstruction, using ROOT. Bragg peak data is used for particle identification.

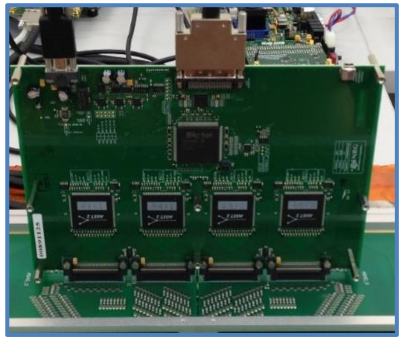


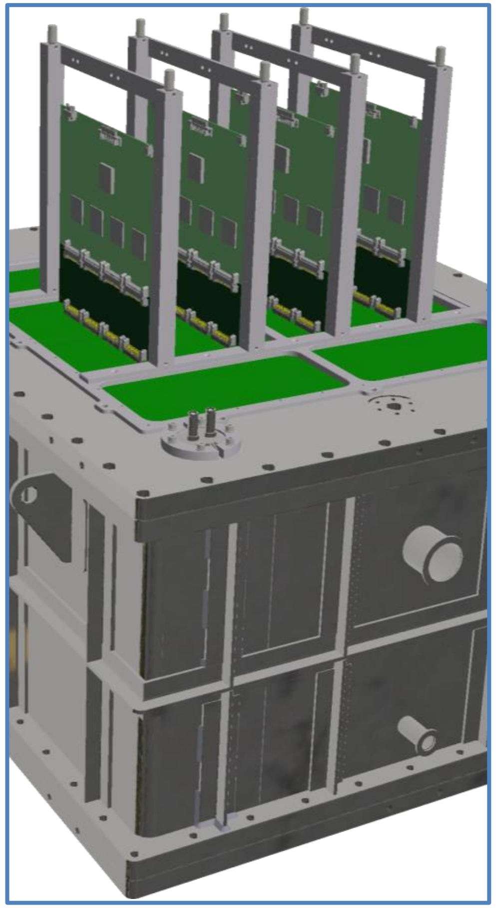
5. When a trigger is detected, complex GET electronics are used to store the charge information from segmented anode and written in channel order as data file.

Joint project with University of Warsaw: The ELI-NP Time Projection Chamber

The ELITPC chamber, cage and detection system are built as in-kind contribution by Univ. Warsaw. The ELI-NP contributions are:

ASAD Boards



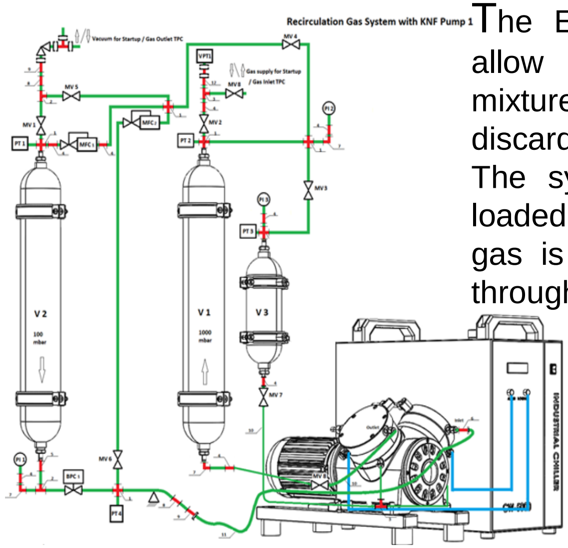


The ASAD boards represent the front-end GET electronics of the TPC.

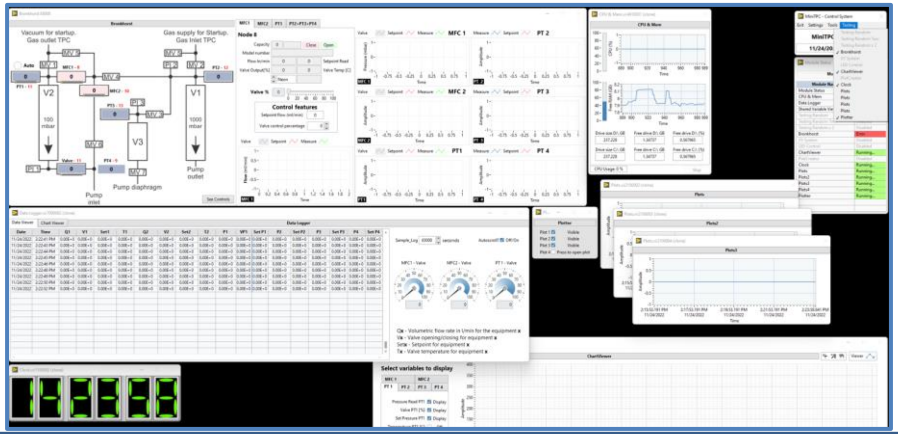
- AGET chip: 64 channels, 100 MHz sampling with 512 time-cells of analog SCA memory per channel (capacitive charge storage for collected electron signal). adjustable gain & filtering per channel.
- 4 AGET chips on each ASAD board, together with an FPGA chip to handle the data flow and a parallel 4 channel ADC.
- each ASAD board can sample 256 channels

While the miniTPC only uses one ASAD board, the future ELI-TPC will use 4 such boards. These boards will then interface with the CoBo DAQ board, which uses another FPGA to handle data flow from multiple boards and can output a processed ROOT file.

Recirculation Gas system



The ELI-NP Gas Recirculation System will allow the usage of different gases and mixtures, which can either be difficult to discard or are too expensive for one time use. The system has a buffer volume which is loaded from the gas supply, then this buffered gas is consinuously recirculated and filtered through the TPC system. This system is indispensable for using exotic gases, which will enable exotic reactions to be studied. The Gas Recirculation System will be fully automated with its dedicated Slow Control interface and is designed to integrate with the future ELI-TPC.



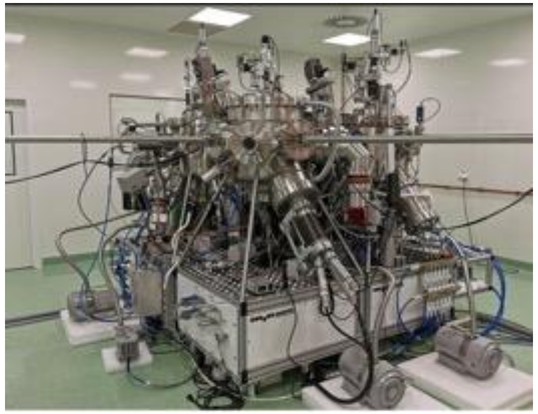
Laboratory Support

Optics Laboratory (D. Ursescu)

Bio Laboratory (M. Voda)

Target Laboratory (V. Leca)

A target laboratory support for fabrication and characterisation of solid targets



Dosimetry Laboratory (I. Mitu)

Personnel and area dose monitoring
Radioprotection training

Laser Experiments Diagnostics Laboratory (V. Nastasa)

A laboratory support for testing and setting up diagnostics, and processing/analyzing detectors/films (e.g., CR39 etching)

LP14 laboratory

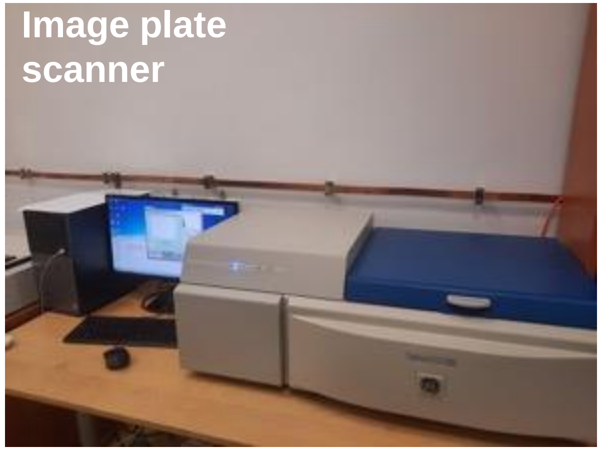


Image plate scanner

Laser cutter machine for RCF

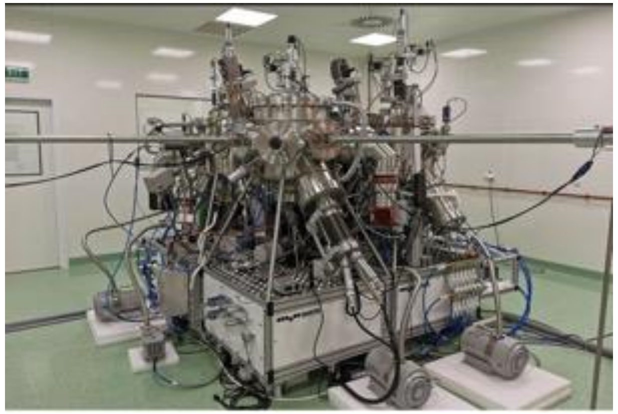
Testing vacuum

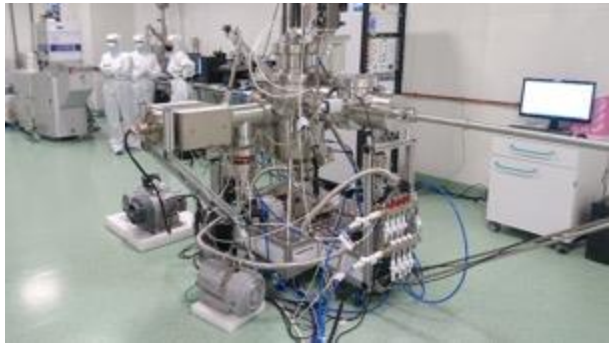
RCF scanner

http://www.eli-np.ro/labs.php

Target Laboratory Support

Capabilities:	Tools:
Fabrication of (ultra)thin/thick films (free-standing or supported)	RF/DC sputter deposition, e-beam evaporation, spin-coating, electro-chemical synthesis.
Micro/nano-structuring (gratings, nanoparticles, nano-wires, nano-pillars, low density (porous) materials	Electron-Beam Lithography, photolithography, Reactive Ion Etching, Ar-ion milling, chemical methods
Characterization (Surface characterization, elemental composition, morphology and topography, roughness, interface analysis)	X-ray diffraction, Atomic Force Microscopy, Scanning Electron Microscopy with Energy-Dispersive X-Ray Spectroscopy and Electron Backscatter Diffraction, optical profilometry and microscopy
Surface treatments	Thermal treatments, polishing, surface reconditioning, plasma surface cleaning
Micromechanical and micro assembly	Wafers cutting, targets frames, micromachining





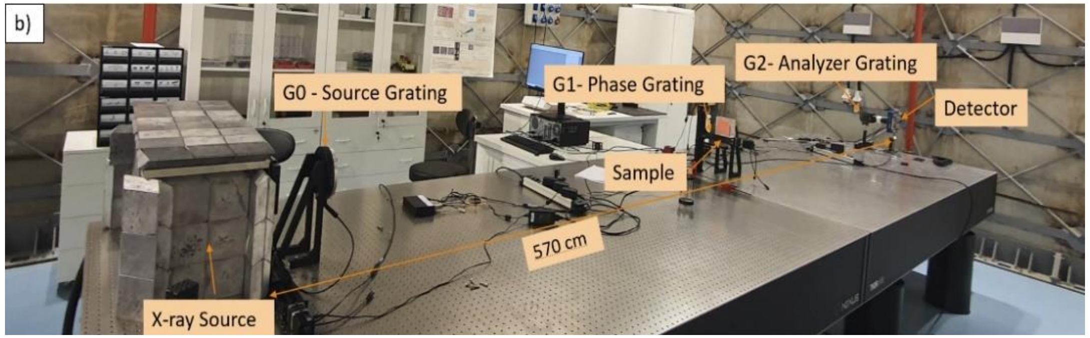
http://www.eli-np.ro/target_lab.php

X-ray Imaging Laboratory

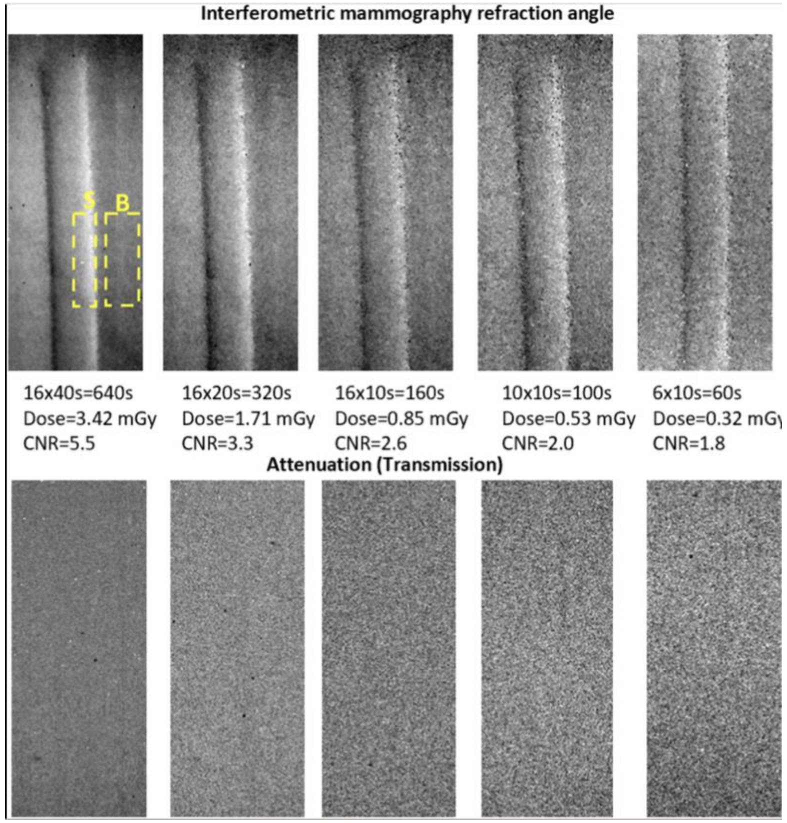
Head of laboratory: Eng. Nicoleta Safca

Focuses on: development of a laser-based low-dose interferometric breast imaging, towards an improved modality of breast cancer screening, and more sensitive and precise X-ray image guidance in radiotherapy.

- located in the E3 room of the experimental building – vibration damping, control of humidity and temperature, and radioprotection infrastructure.
- main asset - a large radioprotection room (8600 mm x 6000 mm x 2200 mm) designed and equipped for high-sensitivity X-ray phase-contrast imaging experiments.
- the work of the team in this laboratory is dedicated to the **development of X-ray diagnostics** for laser-target interaction, **biomedical X-ray imaging applications, industrial applications**, **fundamental science**, and **experiments for X-ray optics**.



5.7 m long X-ray interferometer at ELI-NP X-ray Imaging Laboratory



750 µm fibril mimicking early-stage breast cancer
N Safca *et al* 2022 *Phys. Med. Biol.*

https://www.eli-np.ro/xray_lab.php

- Experiments at ELI-NP show potential of phase contrast with long interferometers;
- Much more sensitive and precise imaging using much reduced dose;
- Potential for very high and near term medical impact;
- Result obtained with conventional X-ray tube and hundreds of seconds image acquisition time; 0.01-1 s needed for clinical imaging;
- Laser-based X-ray sources can provide the ultraintense, directional, and spatially coherent X-ray beams ideal for phase contrast (“table-top synchrotron”)

First User Call – June 2022

eli IMPULSE eli Nuclear Physics

Common Call with ELI ERIC

Access Agreement / Terms&Conditions
Period: October 2022 – March 2023
ELI-NP 17 proposals: 6 @ 100 TW & 11 @ 1 PW

ELI-NP Program Advisory Committee (PAC)

On-site Meeting: 3-4 October 2022

Peter Thirolf (Chair)	Technische Universität München
Leonida Gizzi	INO-CNR Pisa
Karl Krushelnick	CUOS - University of Michigan
Paul McKenna	University of Strathclyde, Glasgow
Akifumi Yogo	ILE, Osaka University
Victor Malka	Weizmann Institute of Science
Antonino di Piazza	Max-Planck Institut für Kernphysik

ELI-NP PAC Recommendations

Grade A: 1 @ 100 TW, 2 @ 1 PW
Grade A-: 2 @ 100 TW, 4 @ 1 PW
Grade B: 3 @ 100 TW, 5 @ 1 PW

E4 (100 TW beam)	Accent Pro 2000 s.r.l.	Romania
E4 (100 TW beam)	ELI-NP/IFIN-HH	Romania
E4 (100 TW beam)	ELI-NP/IFIN-HH	Romania
E4 (100 TW beam)	Victor Babes National Institute of Pathology	Romania
E4 (100 TW beam)	University of Oxford	UK
E4 (100 TW beam)	Advanced Science and Engineering, Hiroshima University	Japan
E5 (1 PW beam)	AOYAMA GAKUIN UNIVERSITY	Japan
E5 (1 PW beam)	ILE, Osaka University	Japan
E5 (1 PW beam)	CELIA, Talence	France
E5 (1 PW beam)	CLPU, Villamayor	Spain
E5 (1 PW beam)	INRS	Canada
E5 (1 PW beam)	INO-CNR, Pisa	Italy
E5 (1 PW beam)	Moscow Engineering Physics Institute	Russia
E5 (1 PW beam)	Soreq NRC, Yavne	Israel
E5 (1 PW beam)	Tata Institute of Fundamental Research	India
E5 (1 PW beam)	TU Darmstadt, GSI	Germany
E5 (1 PW beam)	Institute of Plasma Physics and Laser Microfusion, Warsaw	Poland

- User portal and user safety training (online) developed within IMPULSE project

Summary

Nuclear Physics

- 10 PW laser system fully operational on all outputs
- 10 PW LBTS successfully commissioned
- Laser experimental areas E4 (100 TW) and E5 (1 PW) installed and commissioned
  - First results confirm expectations
- Commissioning of 10 PW experimental area E1 ongoing, and E6 coming soon
- User experiments – first call for users - October 2022 – May 2023, ongoing at 1PW
- Second user access call with ELI ERIC – ongoing, deadline March 24th for ELI-NP

EUROPEAN UNION

GOVERNMENT OF ROMANIA

Structural Instruments
2014-2020

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

Thank you!

IMPULSE

IMPULSE has received funding from the European Union's Horizon 2020
Research and Innovation Programme under grant agreement No 871161

www.eli-np.ro