

Examples of targets at ELI Beamlines CZ, BIS



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Presentation outline

- 1. Localization and structure of ELI Beamlines
- Map and organizational structure
- Laser systems
- Building schemes
- 2. Target and Bio- & BioChemLABS
- Space and plan
- Equipment
- 3. Manufactured and utilized targets
- Types of tested targets
- Plans for improvement and developmnet









Localization and structure of ELI Beamlines



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ELI Beamlines – Localization











ELI building overview



Research program 1:

Rep-rate & multi-PW laser development Research program 2 (in E2/E5):

X-ray sources driven by rep-rate ultrashort laser pulses

Research program 3 (in E4/E5):

Particle acceleration & applications **Research program 4 (in E1):**

Applications in molecular, biomedical & material sciences

Research program 5 (in E3):

Laser-plasma interaction, high-energydensity, lab-astrophys., UHI **Research program 6 (in E3):**

High-field physics, theory and simulation

➔ plus engineering, IT, administration: ca. 275 people (2015) from 23 nations !!!









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AVOJA L1 laser (2017)

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Peak power	5 TW (10 ¹²)
Pulse energy	Up to 100 mJ
Pulse length	20 fs
Repetiion rate	1 kHz



LUCIFER L3 laser (2017) Peak power.....1 PW Pulse energy.....30 J Pulse length.....30 fs Repetiion rate......10 Hz

ELI Beamlines laser systems



AMOS L2 laser (>2018) Peak power.....1 PW (10¹⁵) Pulse energy.....15 J Pulse length......15 fs Repetiion rate......10 Hz



KRAKATIT L4 laser (2018) Peak power......10 PW Pulse energy......1,5 kJ a 150 J Pulse length......1 ns to 150 fs Repetiion rate......1 per/min.









Target-, Bio- & BioChemLABS



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Target and BioLABs at ELI Beamlines

BioLAB building, including main TargetLAB	2 floors 16 x 23 m ²	
Auxiliary TargetLAB in the Laboratory Building	28 m ²	
Temporary BioLAB in the Laboratory Building	36 m ²	
Available space for future TargetLAB extension	High ceiling 43 x 34 m ²	



Foreseen equipment for TargetLAB

- Characterization devices
 - Microscope
 - Tabletop SEM
 - Optical profiler
 - Tools
- Characterization tools for checking targets t uniformity, quality, features, damages, material changes, effects after interaction with laser beam
- ISO 8 cleanroom











BioChemLAB – August 2016





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Equipment in BioChemLAB

- environments:
 - chemical fume hood (width: 150 cm)
 - hazardous chemical storage cabinets (corrosives, flammables, toxics)
 - biological safety cabinet/box (width: 120 cm)
 - inert gas glove-box (acrylic, w: 85 cm) with transfer chamber (30 cm)
 - refrigerator-freezer (+4°C/-18°C), deep freezer (-85°C)
 - temperature controlled water bath
 - ultrasonic bath (heated, 3 liters capacity)
 - forced convection ovens / sterilizers (up to +250°C)
 - small unit for purified deionized water (type I)
- tools:
 - magnetic stir plates, shakers, and a vortexer
 - pipettors
 - centrifuges (small: 15000 rpm, large: 4200 rpm)
 - glassware, plasticware
 - starting chemicals (acids, bases, buffer salts, organic solvents)

- instruments:
 - analytical balance (+/- 0.01 mg), precision balances (+/- 10 mg)
 - UV-VIS-NIR spectrophotometer (190-1200 nm) for liquid cells
 - upgrade for solid sample reflection spectra possible
 - compact fiber spectro-fluorimeter with LED excitation sources
 - primarily for liquid samples
 - optical stereomicroscope (8x 80x magnification, trinocular)
 - can be upgraded with a digital camera
 - a volt-meter for measuring pH, oxido/reduction potential, or selected ions with special electrodes
 - The engineering team's **3D printer** will also be located in the ChemLAB









Examples of manufactured and tested targets by ELI BL



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Polymer foil with polystyrene nanoballs





Target consists of two aluminum plates with holes, thin (500 & 900 nm), polymer (PET) foils and polystyrene spheres deposited on foils , sandwiched between plates.





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Polymer foil with polystyrene nanoballs – development

Deposition is manual and hard to control. Existing ideas for development:

• Spincoating •Must be evaluated in

•Must be evaluated in terms of waste material and adjusted

- Automated disposal of polystyrene beads solution
 - •Step motor •Microliter syringe •Capilaries

Metallization











Micro- and nanostructured silicon nitride

Silicon nitride thin (700 nm) membrane deposited on Si wafer with etched grating pattern. Prapared in collaboration with FBK Trento (A.Picciotto).





- Dual frequency PECVD
- HF/LF layers for low stress films
- Lithography
- Etching







More results on poster







EUROPEAN UNION European Structural and Investing Funds Operational Programme Research, Development and Education

FONDAZIONE BRUNO KESSLER





Strong magnetic field generation target







3D printed tools by T. Wiste

More results on poster





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Target survey results

The main interest and requirements in terms of composition & materials:

For foils few nm - >100 um

- Polymers films (C_xH_y, parylene, PET, PS)
- Metallic layers (Au, Ti, Ta, Cu, Fe,...etc.)
- Deutered polymers
- Diamond layers (crystallinity demands?)
- Graphite and well chracterized materials in terms of composition
- Cryogenic targets (layers, ribbons) Specific materials:
- Metallized polymers

Gratings:

- 1D
 - SiN, step, sinusoidal, etc. patterns
- 2D
 - SiN, step, sinusoidal, etc. Patterns

Specific gratings:

- Thick ~ mm range gratings
- Step (laser wavelength), depth (hundreds of nm) shape(various)

Main specifications:

- Areas even up to 25 x 25 cm² or in other cases few mm²
- Up to 3 experiments per year, up to 1000 sh./year
- Usually 1sh./hour for carbon up to 10 Hz for metallic
- 70-90% of utilized targets

5 groups x 5 ex./year x 1000 sh. = 25.000 sh. or ~1.5 m² of material

Multilayers 1-10um

- Carbon and metals e.g. C/Cu/C, C/Au/C...
- Polymers
- Specific materials
- BaTiO3
- PbTiO3
- (K_xNa_y)TaO3

>10 um



- Rods
- Wires (thin like few nm's entangled or aligned and ordered carbon fibers, tubes)
- Nanotubes
- Beads
- Nanoparticles
 - All kinds and shapes (10 nm to 3 µm), Metal, metal-oxide, polymers
 - Bio-nano complexes (protein, small viruses), DNA + gold nanoparticles
- Sucrose, salts
 - Particle clusters in areasols (not relevant, just to mention)











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