



Targetry in ELI-ALPS

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Introduction

ELI-ALPS

- Scientific infrastructure
 - Primary sources
 - Secondary sources

Target needs

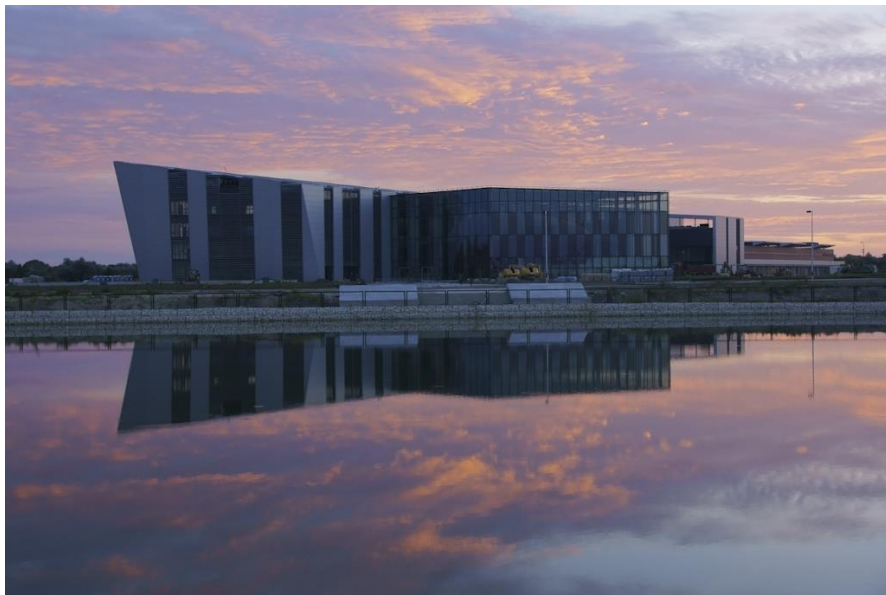
- GHHG
- SHHG
- Particle acceleration

Target laboratory

- Laser facility with sources spanning an extremely broad range from THz to X-rays
- Femtosecond, near-infrared laser pulses, with an unprecedented combination of parameters, will drive various secondary sources resulting in
 - terahertz (THz)
 - mid-infrared (MIR)
 - ultraviolet (UV)
 - extreme ultraviolet (XUV)
 - X-ray radiation
- Pulse durations: from picoseconds (10^{-12} s), femtoseconds (10^{-15} s) down to attoseconds (10^{-18} s)
- Repetition rate: 10 Hz – 100 kHz

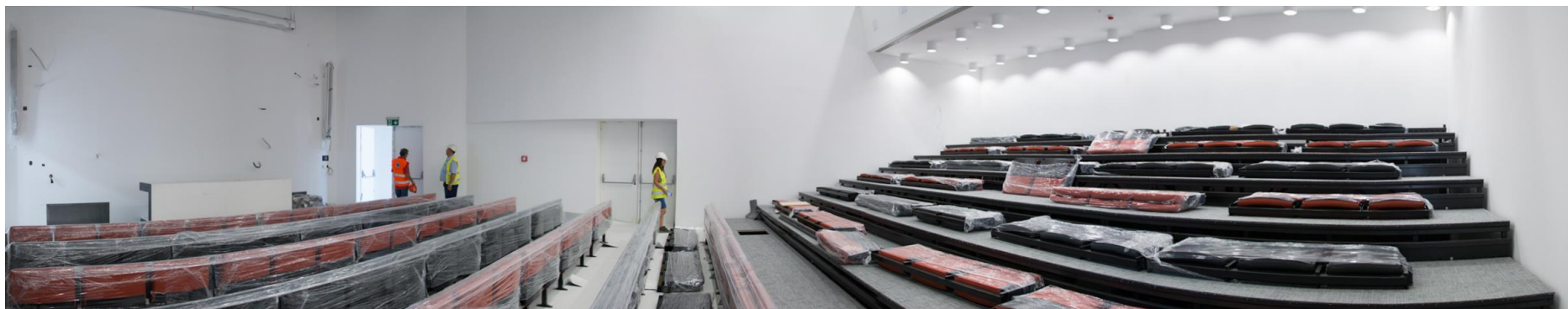
- Attosecond tools for chemistry, biology and nanoscience
 - time-resolved of intra-atomic (-molecular) electron dynamics
- Biological imaging applications
 - high resolution nanometer imaging of biological material
- Bio-medical applications
 - Imaging (phase contrast shadowgraphy or 3D tomography by coherent X-ray beams)
- Energy research (Solar cells to artificial photosynthesis)
 - real-time imaging and investigations in a time-resolved manner for materials and processes of advanced solar cell and battery applications
- High-power photonics
 - upscaling high-power short-pulse laser systems for industrial partners
- Information technology, materials science and nanoscience
 - nanoscale spatial resolution
- THz technologies and applications

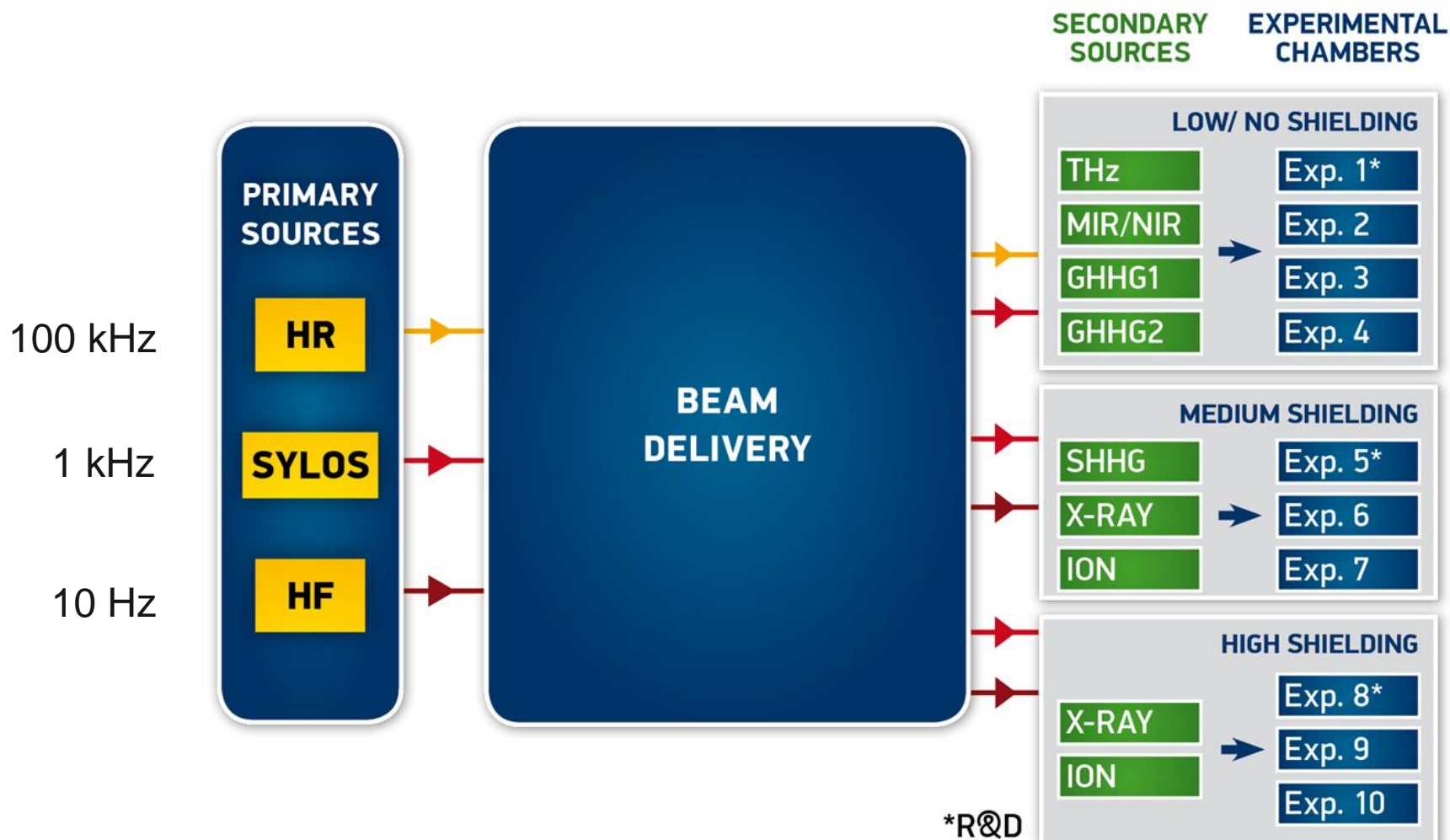
ELI-ALPS – external view





ELI-ALPS – internal view





PRIMARY SOURCES (lasers)							SECONDARY SOURCES				
	Laser system	Peak / average power	Rep.rate	Pulse energy	Pulse duration	Spectral range	UV / XUV	X-ray	Ions	Electrons	THz
Stage 1 (from January 2016 – December 2017)	ALPS-HR	> 0.1 TW / 100 W	100 kHz	1 mJ	< 7 fs (CEP stable)	0.3 – 1.3 μ m	12-300 nm 4-100 eV/10-1 nJ				
	SYLOS	> 2 TW / 20 W	1 kHz	20 mJ	< 10 fs (CEP stable)	0.5 – 1.3 μ m	10 – 400 eV, 120 – 3 nm, 0.4 pJ – 4 pJ GHHG				FIR/THz: 0.3-3 THz, 100 μ m-1 mm, 1.24-12.4 meV / 10 μ J, 3 MV/cm
Stage 2 (from January 2018)	ALPS-HR	> 1 TW / 500 W	100 kHz	5 mJ	5 fs (CEP stable)	0.3 – 1.3 μ m	12-300 nm 4-100 eV/ 50-5 nJ		-	-	
	SYLOS	> 20 TW / 100 W	1 kHz	100 mJ	< 5 fs (CEP stable)	0.5 – 1.3 μ m	10 – 1000 eV, 120 – 1.2 nm, 10 μ J – 10 nJ		-	50-100 MeV, 5-10 pC	FIR/THz: 0.3-3 THz, 100 μ m-1 mm, 1.24-12.4 meV / >1 mJ, up to 100 MV/cm
	ALPS-HF 100	> 40 TW / 50 W	100 Hz	0.5 J	< 12 fs	0.5 – 1 μ m	10 – 1000 eV, 120 – 1.2 nm, 0.5 mJ – 2.5 μ J	1-5 keV, 1.2-12 A/ < 0.3 μ J	Protons: up to 160 MeV 1 nC	2 GeV, 0.2 nC	-
	ALPS-HF PW	> 2 PW / 200 W	5 Hz	40 J	< 20 fs	0.7 – 0.9 μ m	10 – 1000 eV, 120 – 1.2 nm, 1 mJ – 5 μ J	1-5 keV, 1.2-12 A/ < 0.5 μ J			

Targets for Secondary sources and Particle acceleration – include the delivered sources

Receive the needs from secondary sources divisions (e.g. GHHG, SHHG, particle acceleration)

...in progress...

Have to decide in house vs. outsourcing

Individual, micro- and nanostructured targets – in house vs. outsourcing

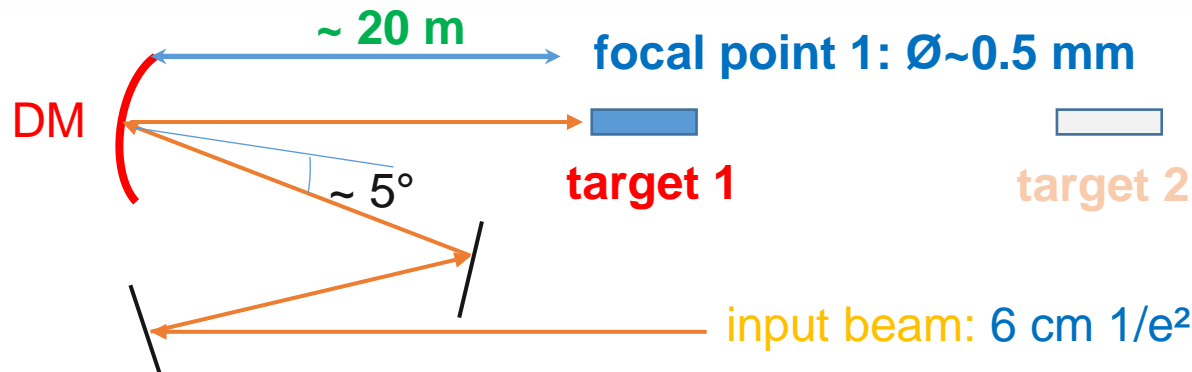
...under discussion...

Gas targets: well developed

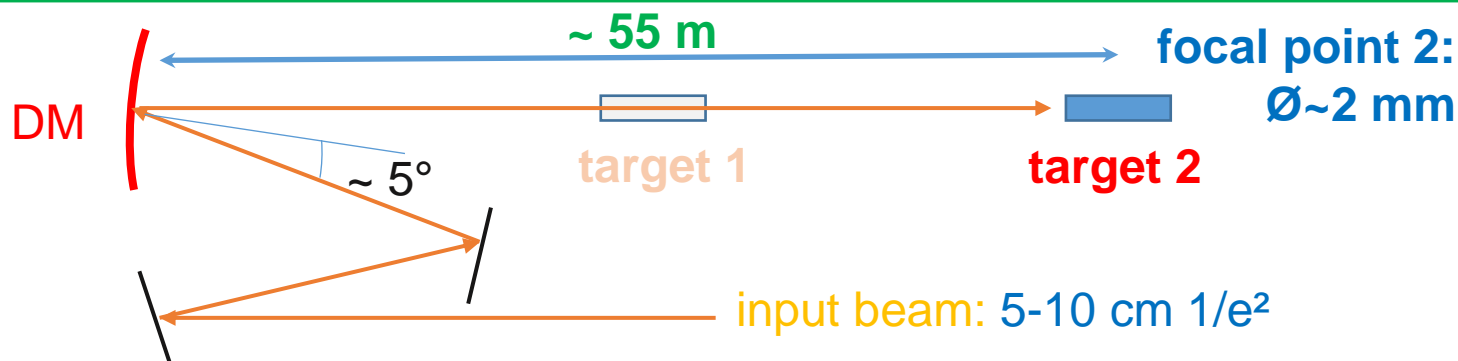
Targets for SHHG and particle acceleration: R&D necessary

SYLOS LONG beam line (1 kHz)

short focus



long focus



SYLOS laser specs (1 kHz)

Parameter	Phase 1/2
Pulse energy	45/100 mJ
Pulse duration	3 cycles/1.5 cycles
Spectrum [nm]	700-1200

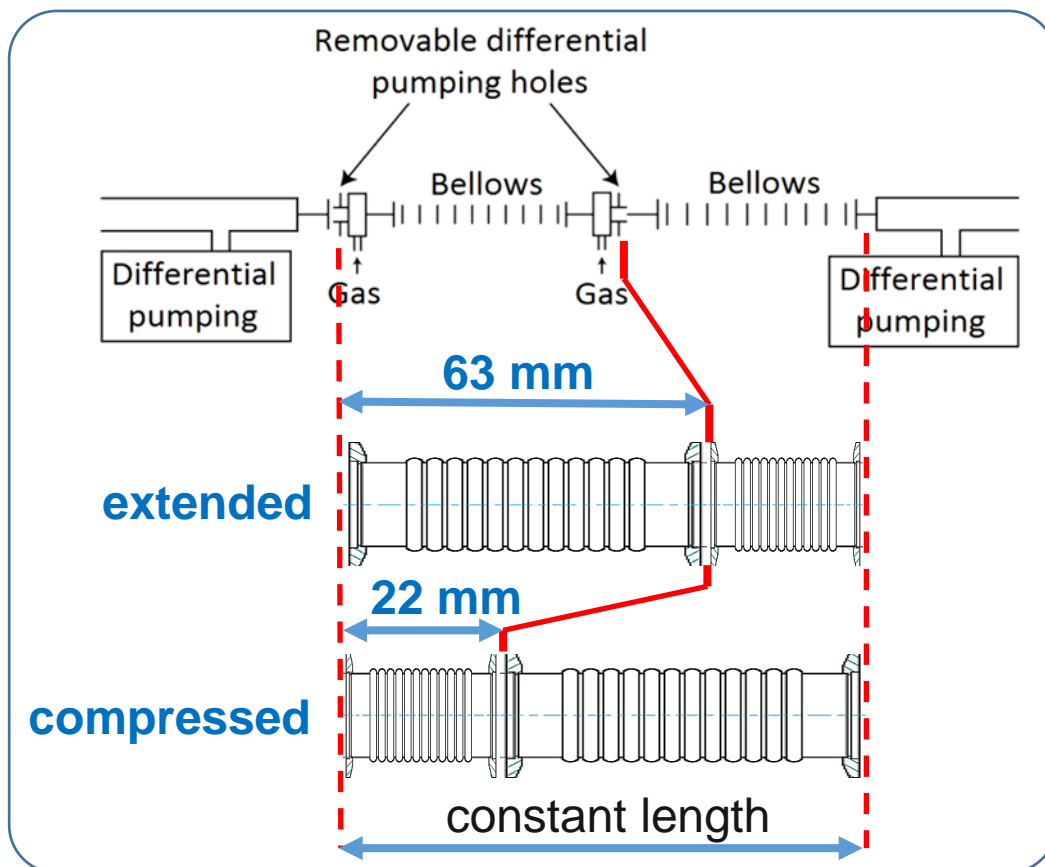


LONG beam line specs

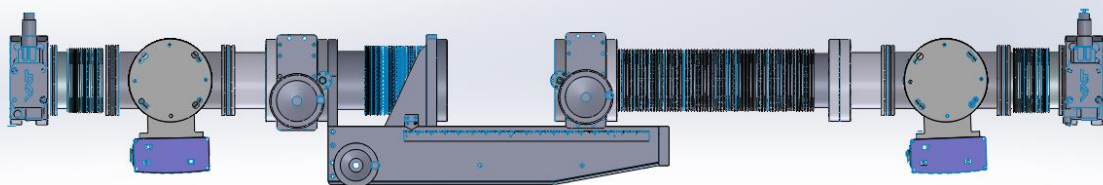
Parameter	Value (1 & 2)
Pulse energy	$>1 \mu\text{J}$
Pulse duration	~ 300 as
Spectrum [eV]	20-150

Variable length gas cell (SYLOS LONG) 1 kHz

target 1: single, adjustable length cell

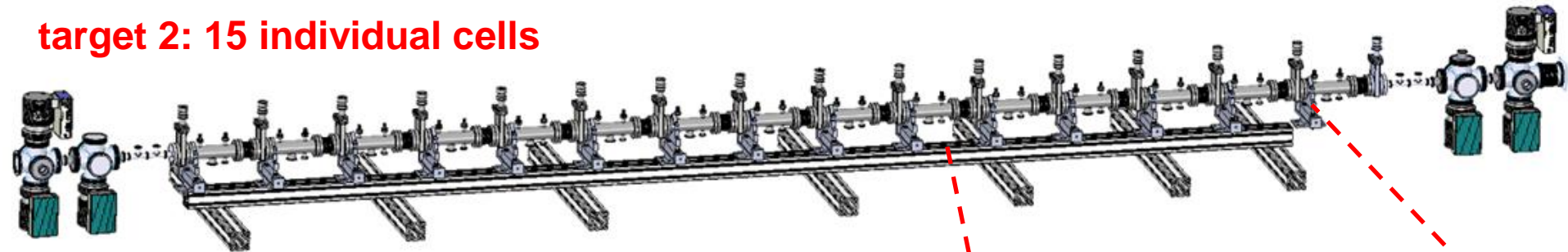


Pressure: 0.1-15 mBar
Gases: noble gases

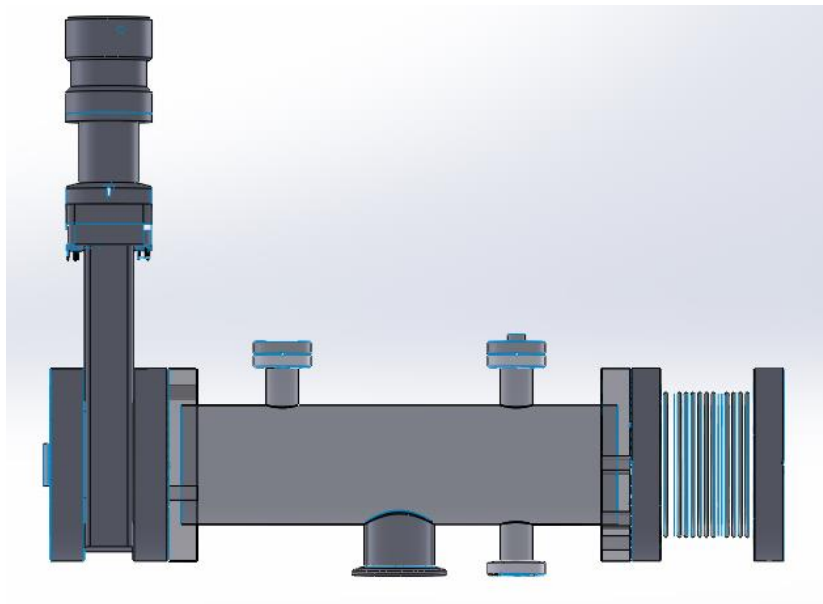


Gas cell chain (SYLOS LONG) 1 kHz

target 2: 15 individual cells

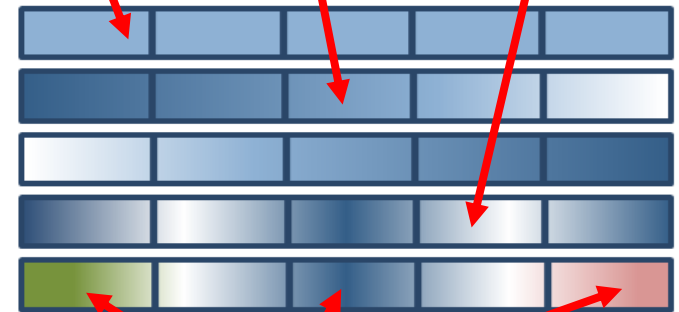


single cell:



uniform pressure
gradient

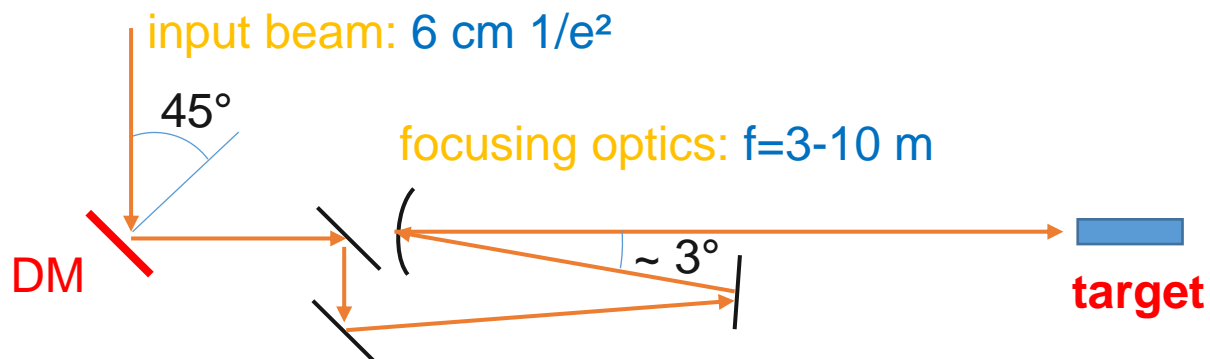
modulation



different gases: Ar, Ne, Kr...

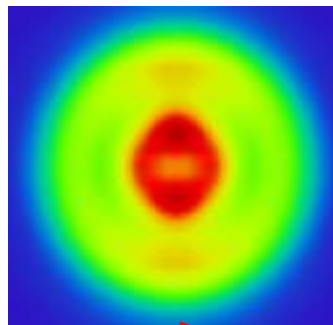
SYLOS COMPACT beam line 1 kHz

COMPACT BL



simulated beam profile

- $I_{\text{peak}} \approx 10^{14} \text{ W/cm}^2$
- $\varnothing \approx 0.5-1.5 \text{ mm}$

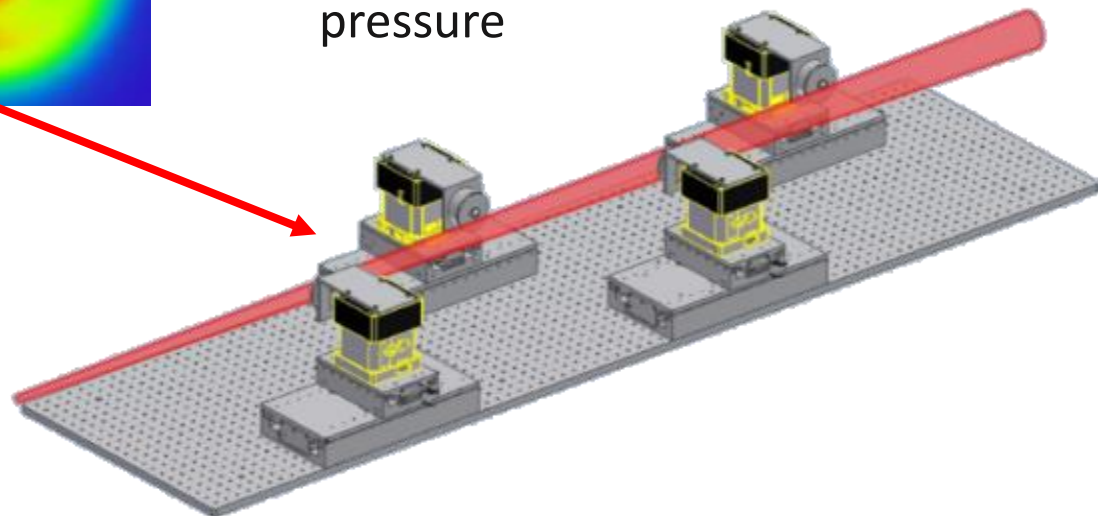


target properties

- 4 gas jets
- 1 kHz operation
- 500 mbar stagnation pressure

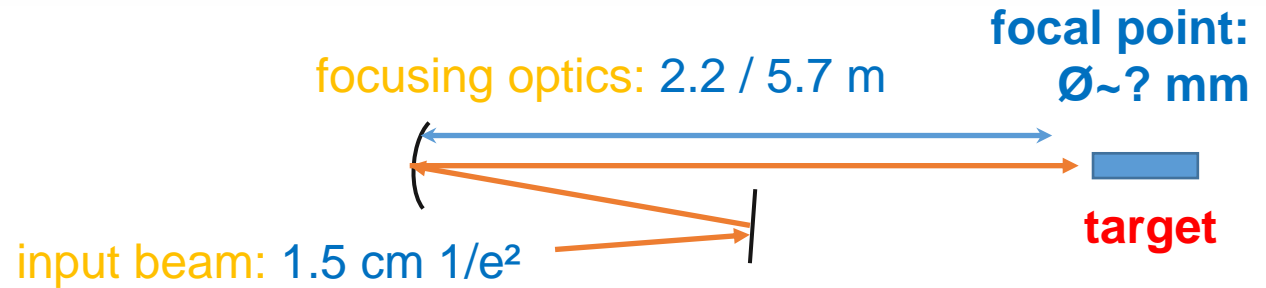
COMPACT beam line specs

Parameter	Value (1 & 2)
Pulse energy	$>1 \mu\text{J}$
Pulse duration	$\sim 300 \text{ as}$
Spectrum [eV]	20-150



HR GAS and HR CONDENSED 100 kHz

HR beam lines



target properties

- static cell
- laser-drilled pin holes
- ? mbar pressure

HR laser specs (100 kHz)

Parameter	Phase 1/2
Pulse energy	1.5/5 mJ
Pulse duration	3 cycles/1.5 cycles
Spectrum [nm]	800-1200

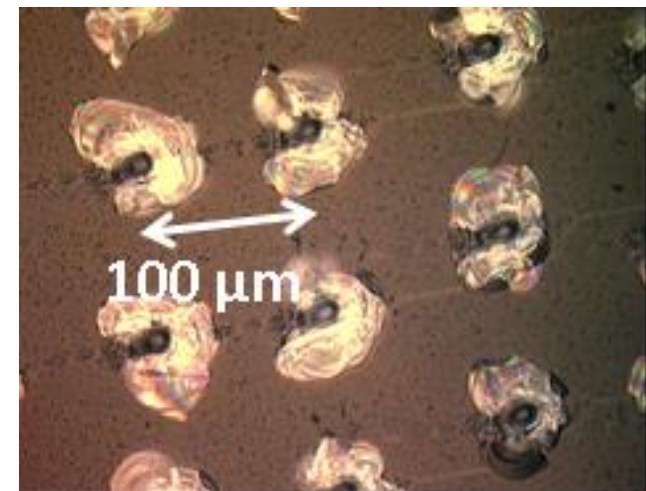
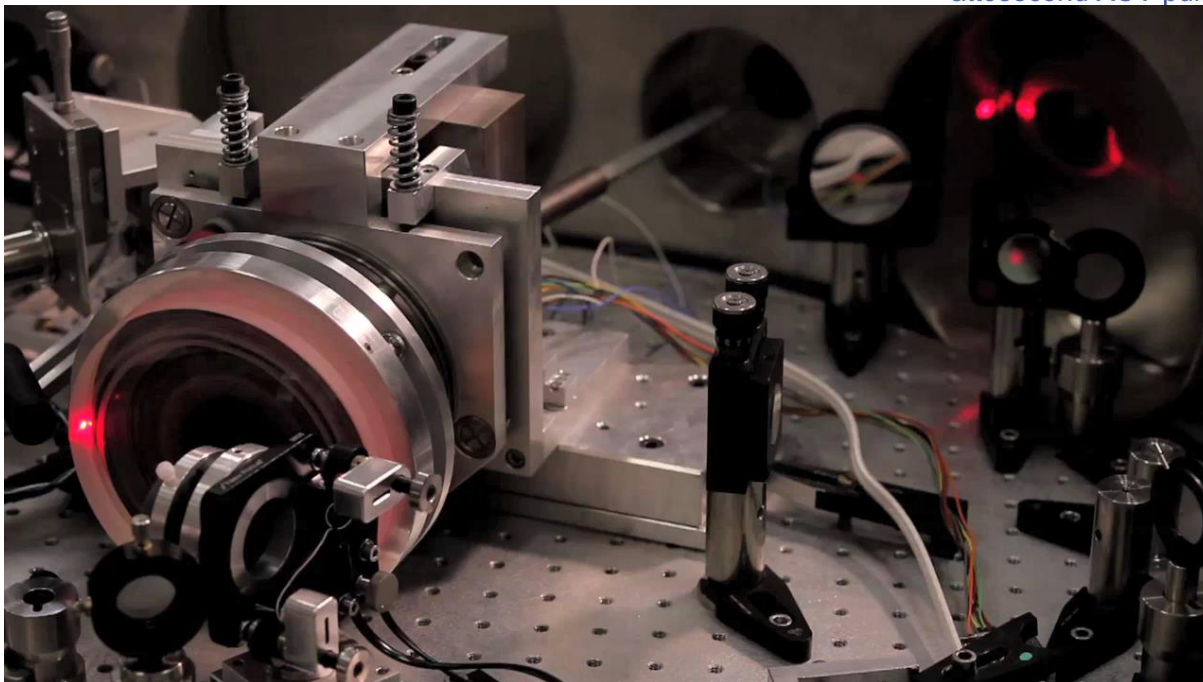
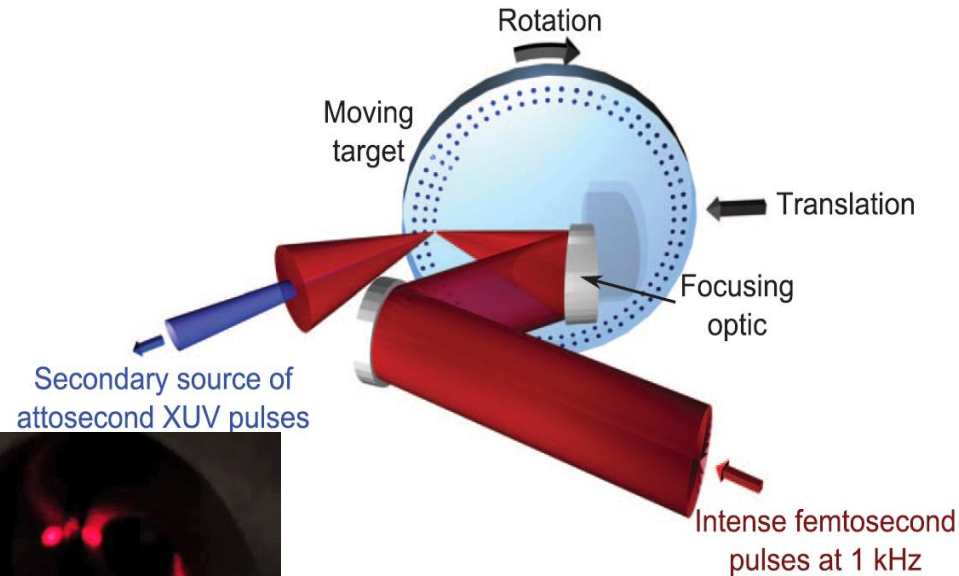


GAS/CONDENSED beam line specs

Parameter	Value (1 & 2)
Pulse energy	>100 pJ
Pulse duration	~300 as
Spectrum [eV]	17-100

SHHG target

- Advantages: working solid state 1 kHz target + PM
- Disadvantages: Long reload time
- Difficulties: Debris generation
- Under development (in LOA)
- Further R&D necessary

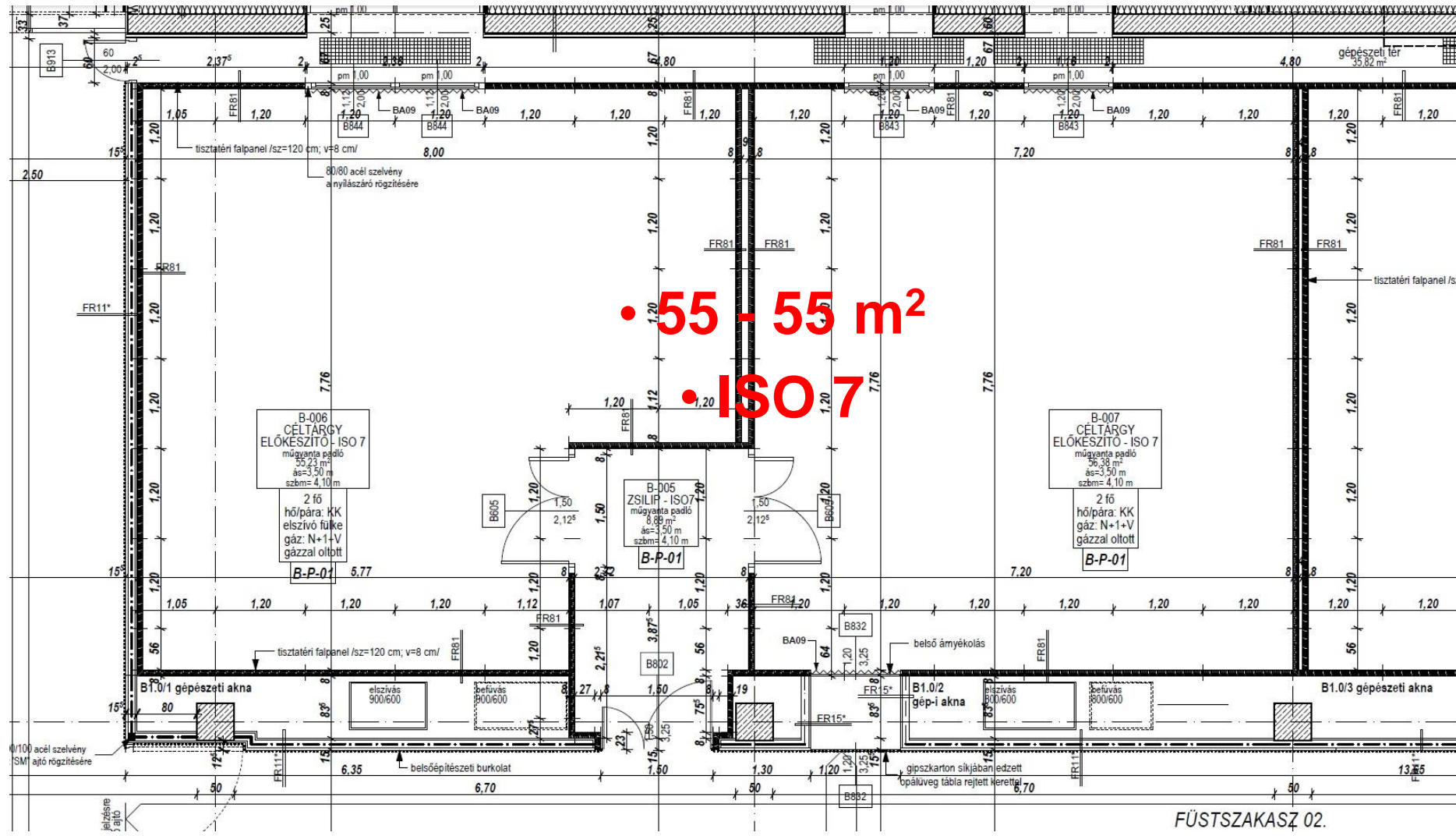


Under specification

- submicron foil in single-shot mode
- few-micron foil in high rep-rate (>1 Hz) mode

R&D necessary

Specification of instruments and strategy:
till the end of this year (after receiving of the specifications of secondary sources)



THANK YOU FOR YOUR ATTENTION!

SZÉCHENYI 



HUNGARIAN
GOVERNMENT

European Union
European Regional
Development Fund



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