ELI-ALPS Research Institute
TOWARDS THE SHARP END OF ATTOSCIENCE

The development of the SYLOS driven beamlines

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12.11.2020

SZÉCHENYI 2020
HUNGARIAN GOVERNMENT
European Union
European Regional Development Fund
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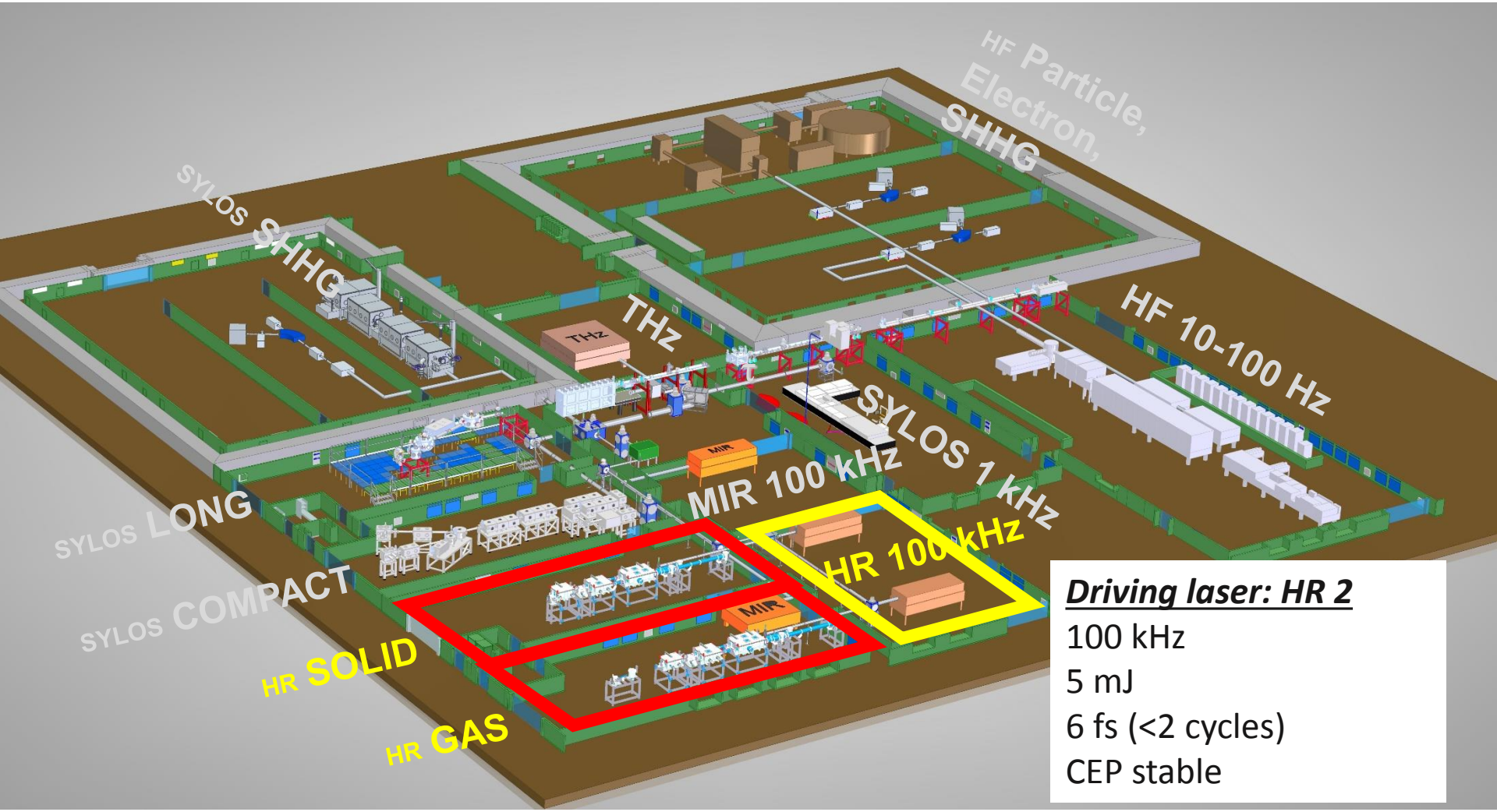
The HR GHHG Beam Lines
Location in Building A



Driving laser: HR 2

100 kHz

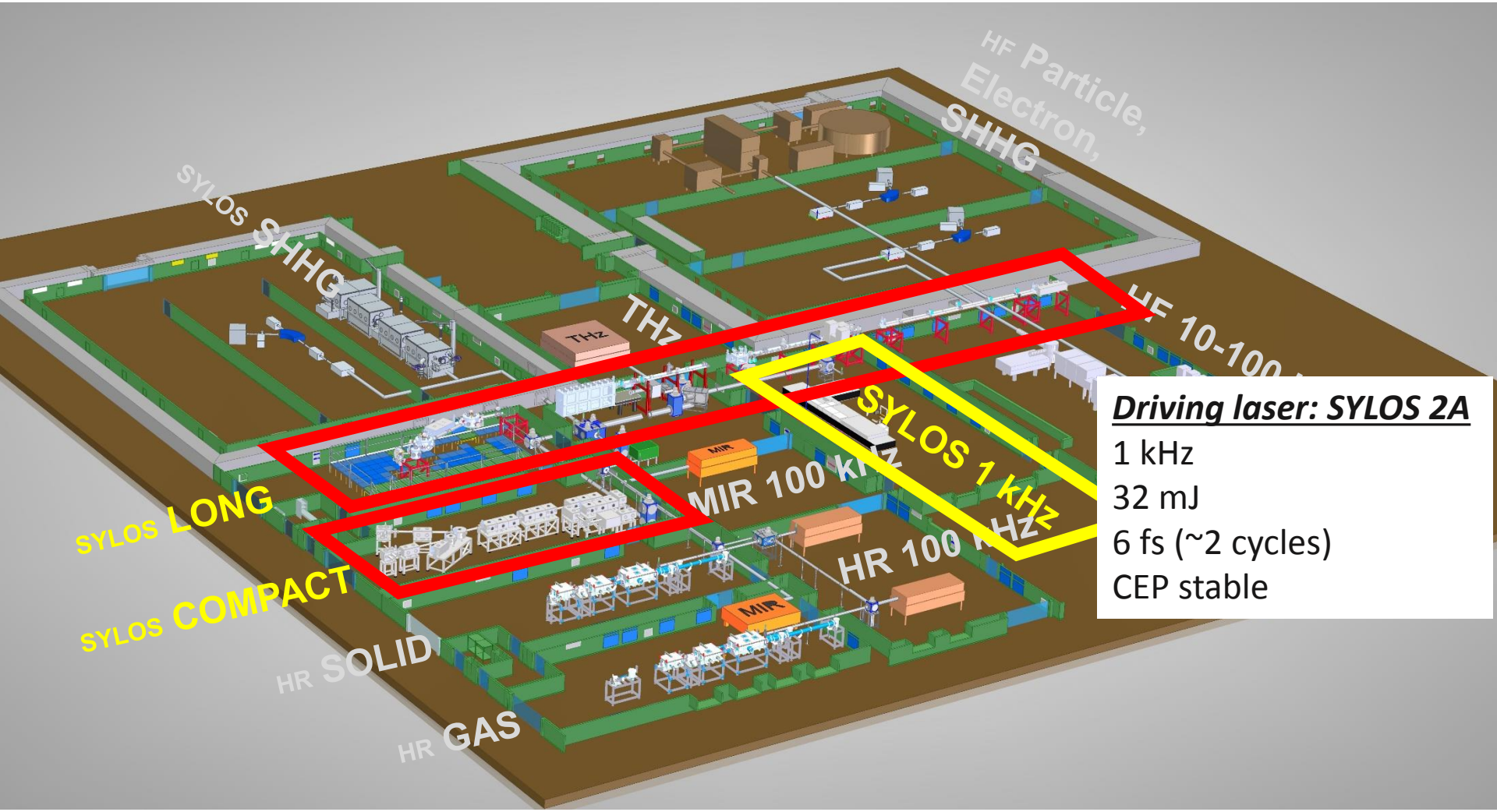
5 mJ

6 fs (<2 cycles)

CEP stable

IR femtosecond pulses → XUV/X-Ray attosecond pulses

The SYLOS GHHG Beam Lines
Location in Building A



IR femtosecond pulses → XUV/X-Ray attosecond pulses

SYLOS GHHG Beam Lines
Goals and Technology

Attosecond pulse sources for user experiments

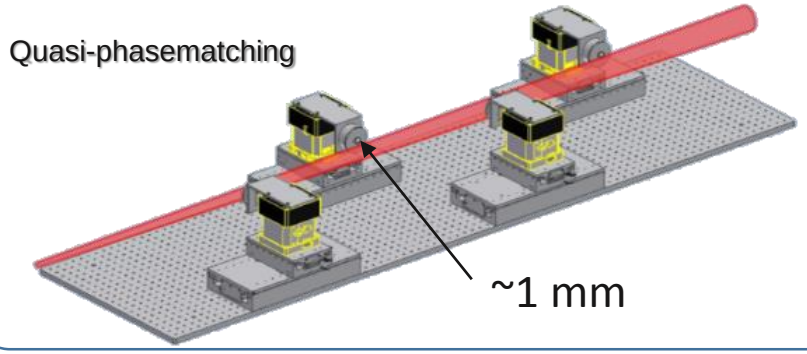
- Highest XUV pulse energies *for multiphoton and multicolor experiments*
- High repetition rates *for coincidence measurements*
- High photon energy *for atomic inner shell dynamics*
- Short pulse durations *for attosecond dynamics*

Approach: Upscaling of well-established High-order Harmonic Generation in Gasses

Two beam lines – Two complementary approaches

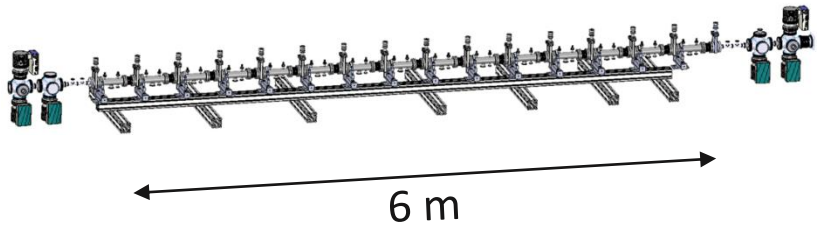
SYLOS GHHG COMPACT

High pressure targets & lose focusing



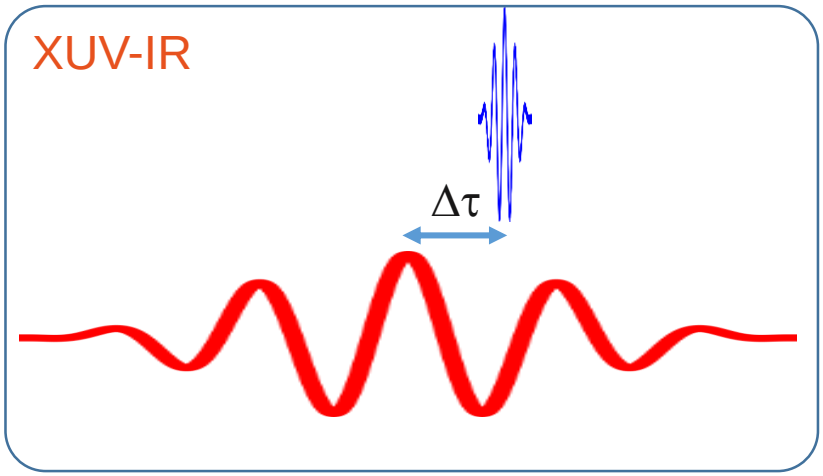
SYLOS GHHG LONG

Low pressure cell & very lose focusing



SYLOS GHHG Beam Lines
Scientific application areas

XUV-IR



SYLOS GHHG

XUV-XUV

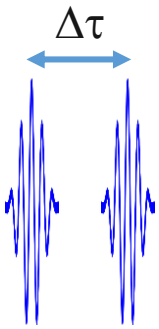


Photo from the Nobel Foundation archive.

AMO Attosciences

- Valence electron dynamics in atoms and molecules
- Inner shell electron dynamics in atoms
- Electronic-Vibrational dynamics in molecules

Ahmed H. Zewail
The Nobel Prize in Chemistry 1999

Born: 26 February 1946, Damanhur, Egypt

Died: 2 August 2016, Pasadena, CA, USA

Affiliation at the time of the award: California Institute of Technology (Caltech), Pasadena, CA, USA

Prize motivation: "for his studies of the transition states of chemical reactions using femtosecond spectroscopy."

Prize share: 1/1

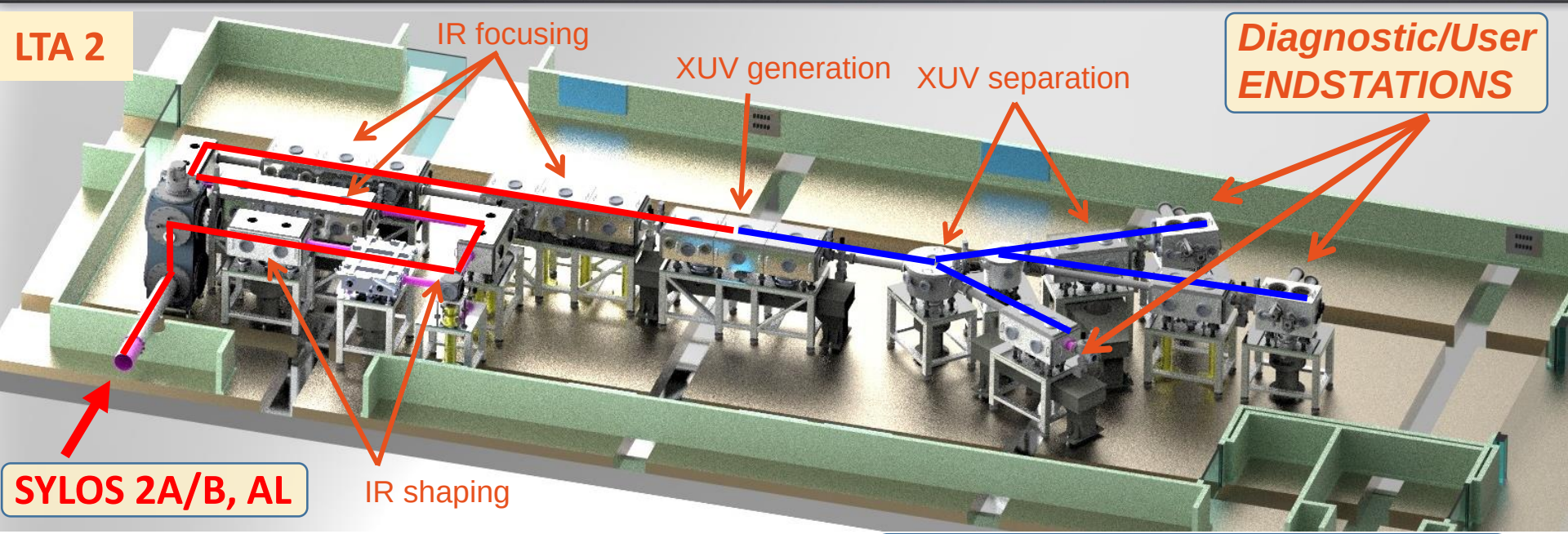
/stems:

s

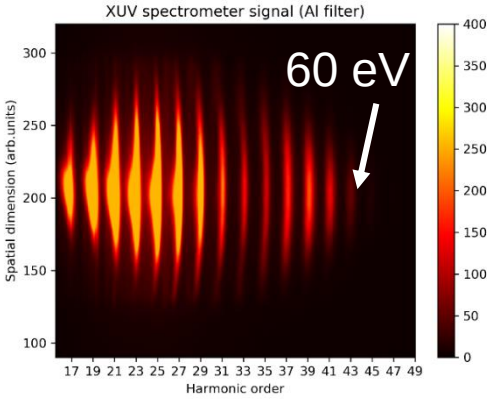
zation

methods (XUV-FROG, 2-IVAC, single shot AC)

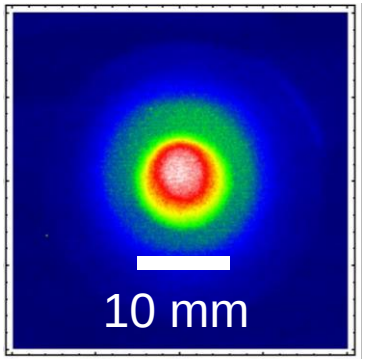
The SYLOS GHHG COMPACT
Anatomy and capabilities



XUV spectrum



XUV beam profile



"Normal" operation output

- at generation: ***few µJ level***
- at end station:

Region	Min-Best
15-30 eV	30-300 nJ
20-50 eV	18-180 nJ
30-70 eV	1.8-18 nJ

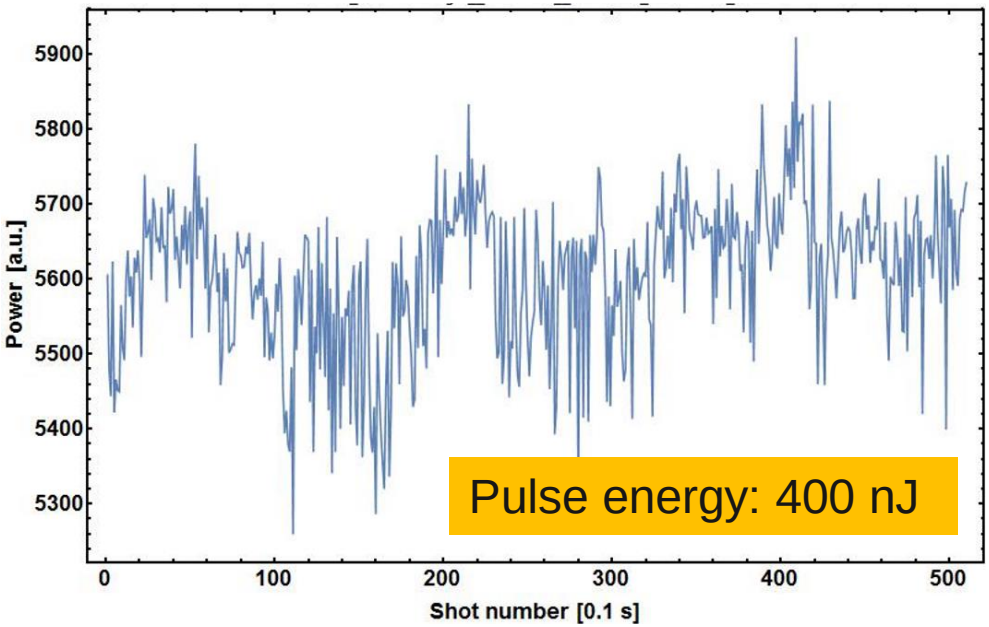
- few/single pulses < 500 as

The SYLOS GHHG COMPACT
Comissioning progress

Short term stability (9 min, shot-to-shot at 10 Hz)

XUV pulse energy stability

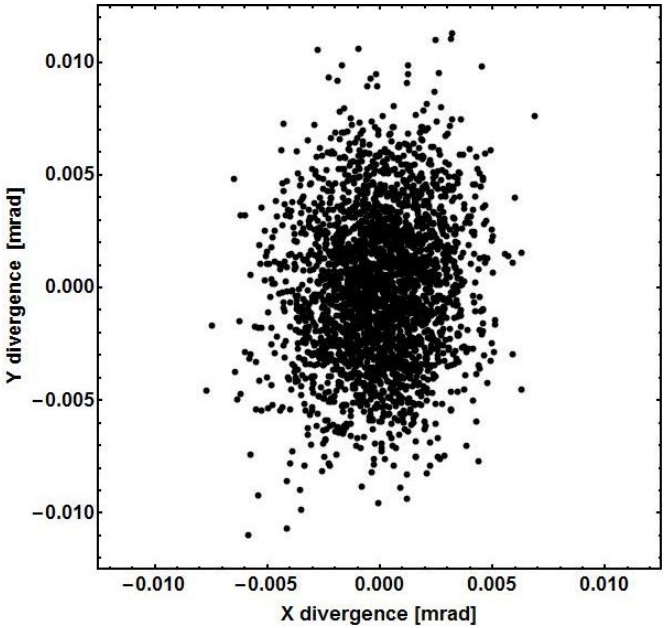
Std.Div.: 1.8%



Pulse energy: 400 nJ

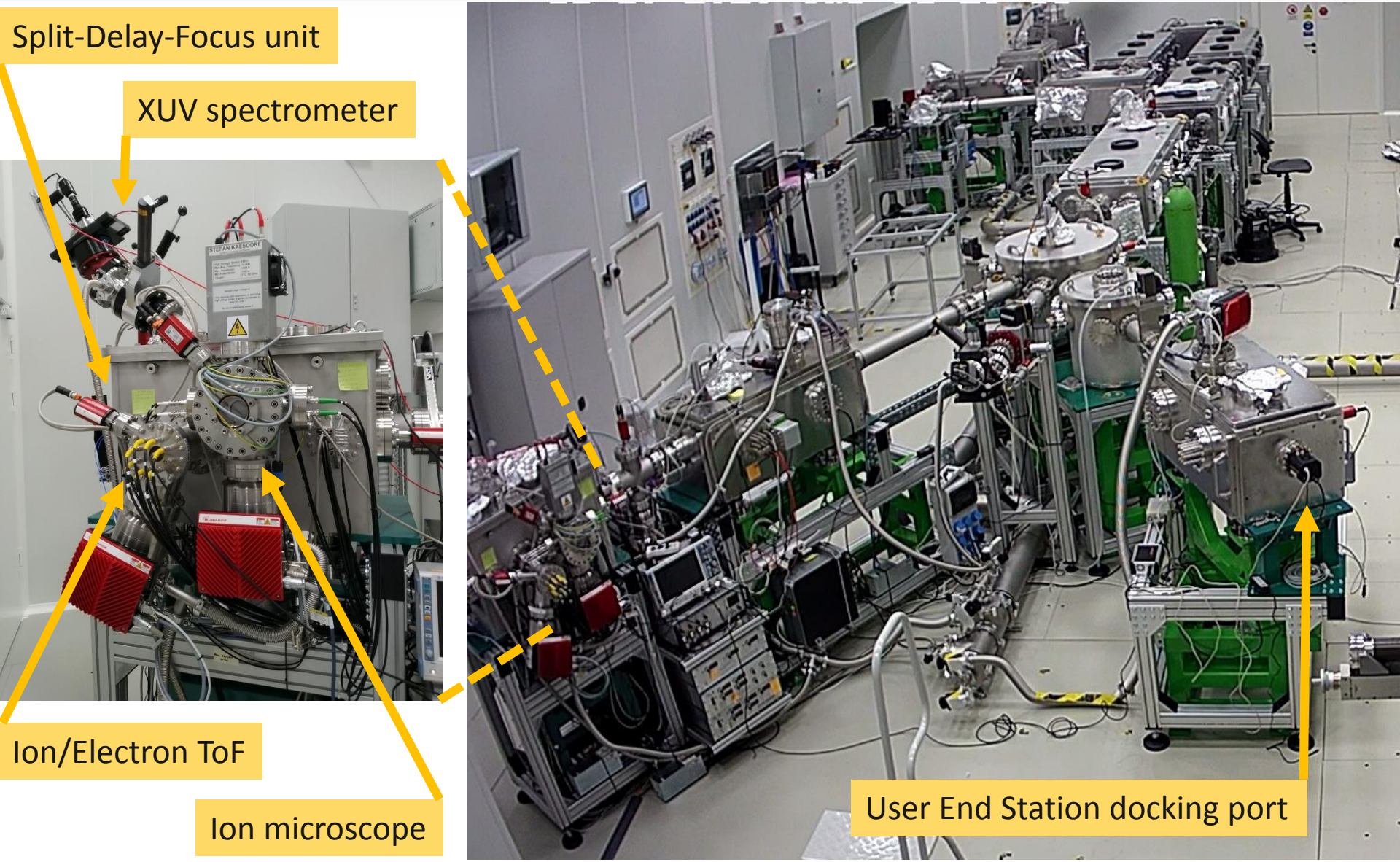
XUV pointing stability

Std.Div.: 2 µrad (for 1 mrad beam)

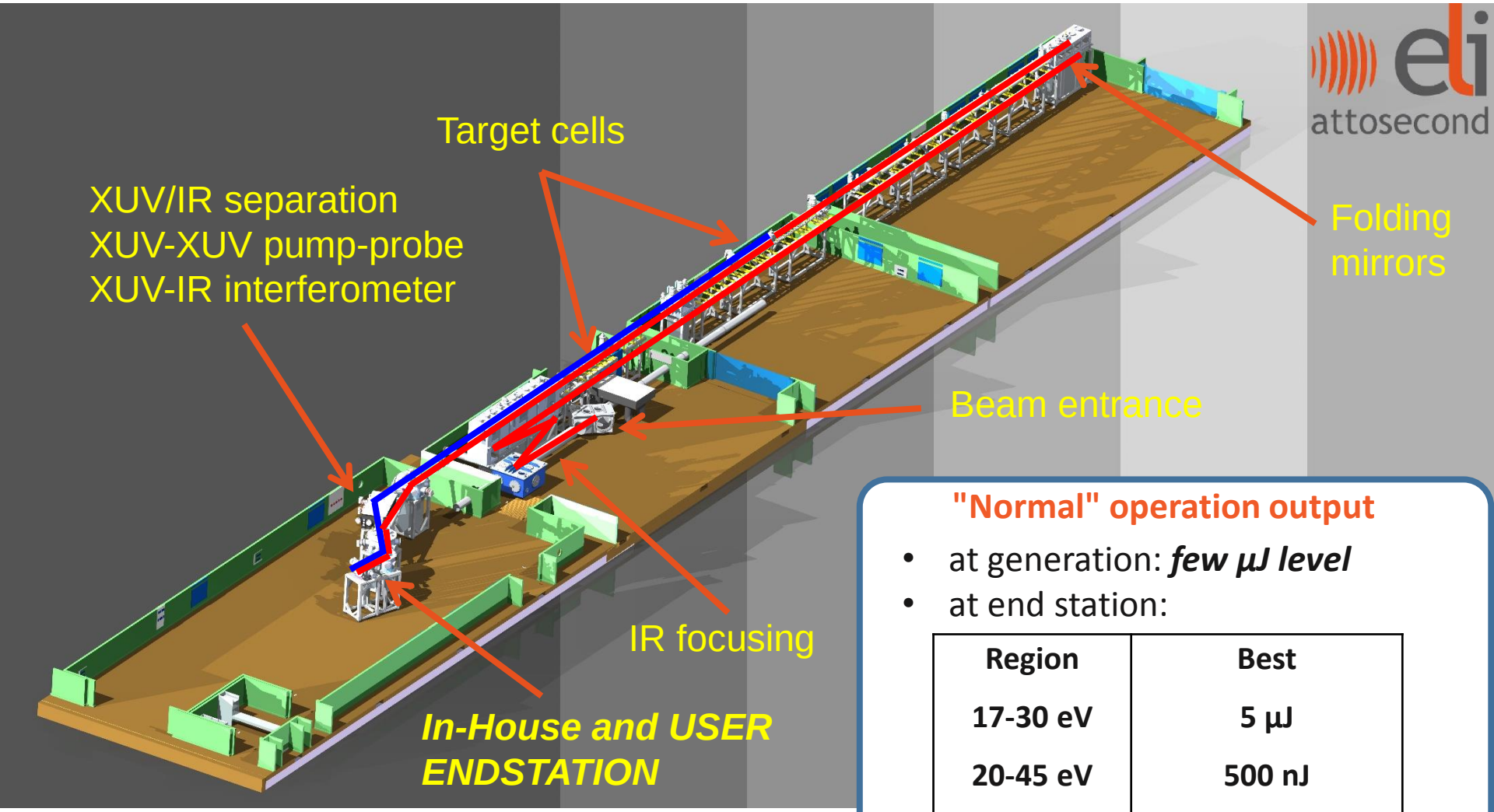


The SYLOS GHHG COMPACT

Comissioning progress



The SYLOS LONG
Anatomy and capabilities



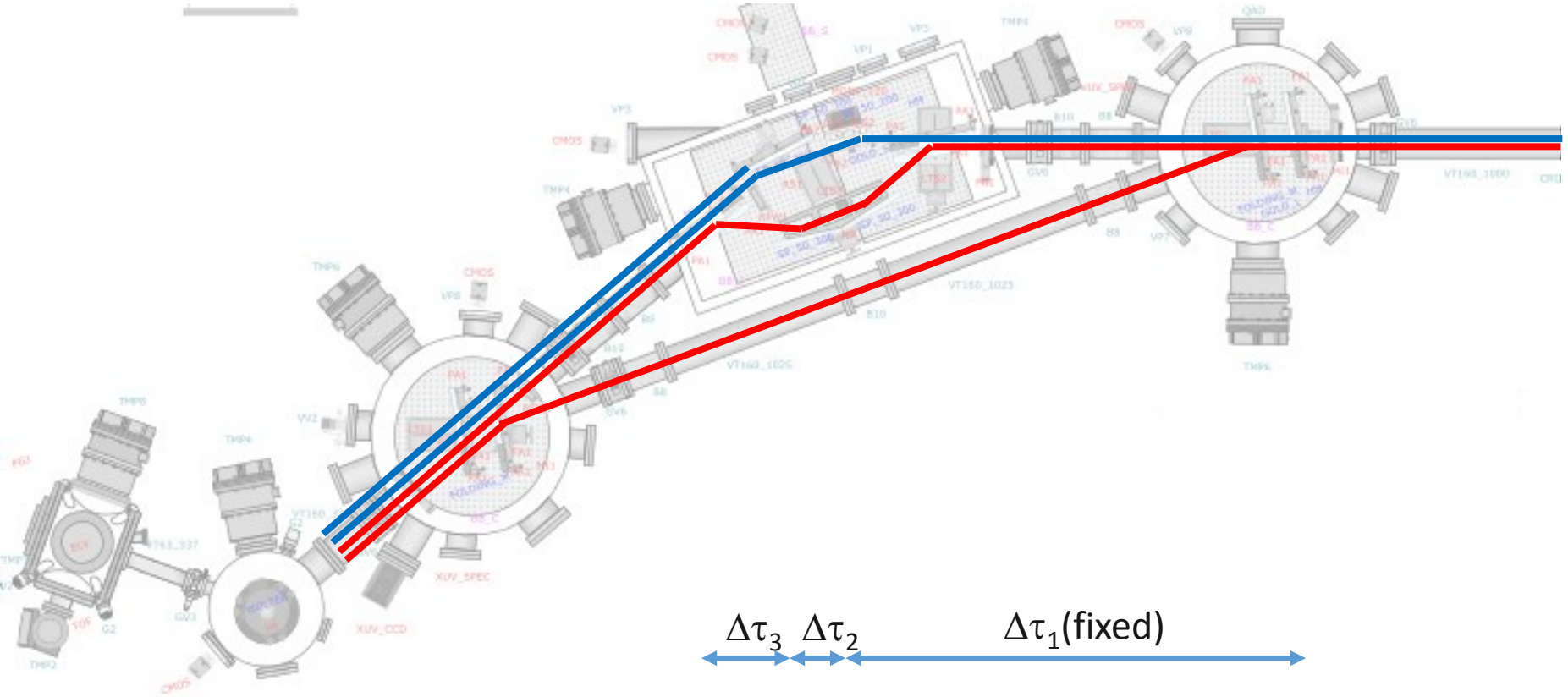
"Normal" operation output

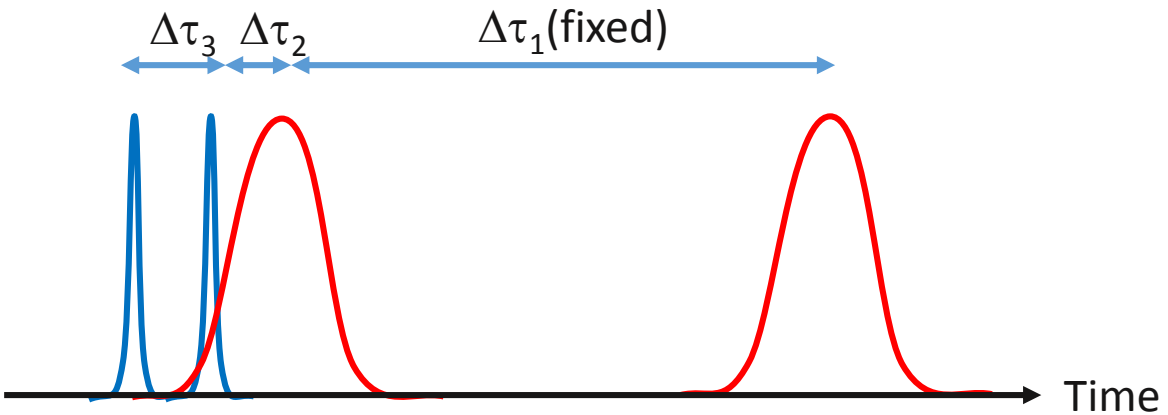
- at generation: ***few µJ level***
- at end station:

Region	Best
17-30 eV	5 µJ
20-45 eV	500 nJ
60-100 eV	5 nJ

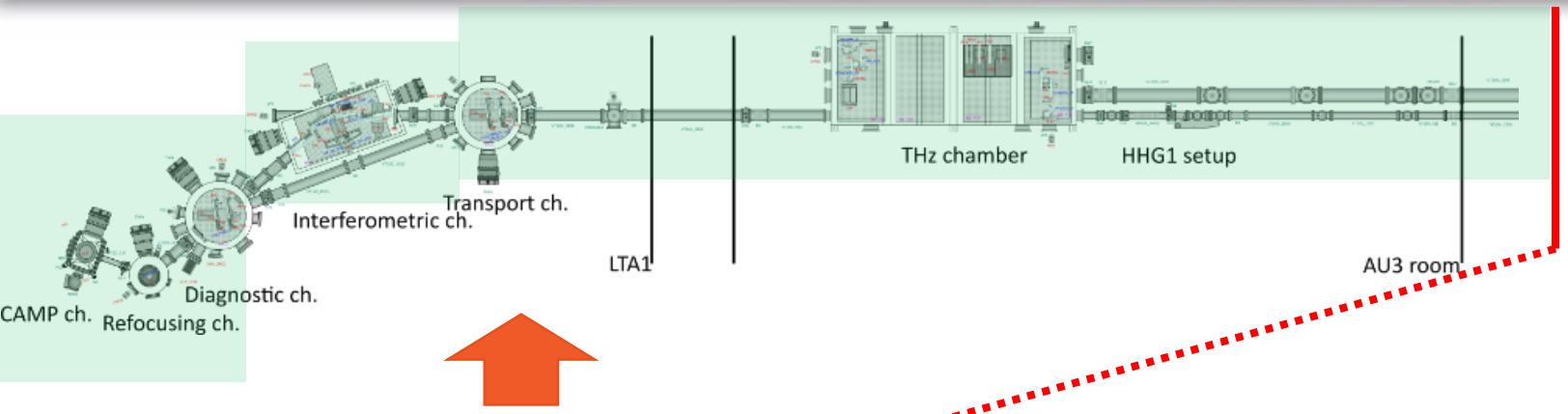
- few/single pulses < 500 as

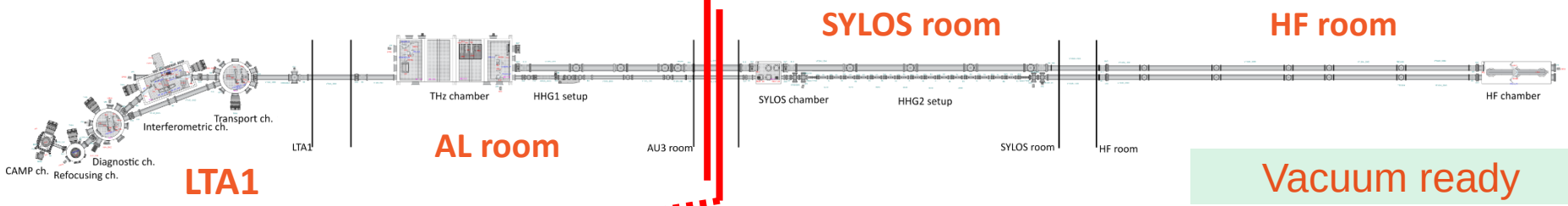
The SYLOS LONG
Multicolor split-delay stage





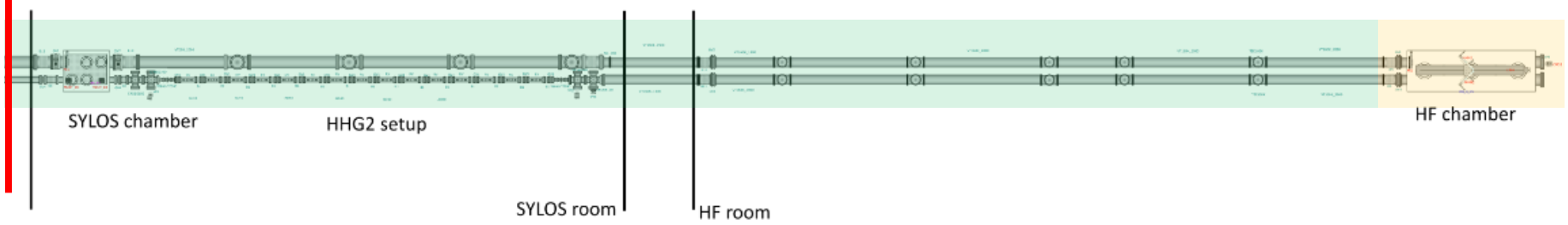
The SYLOS LONG
Construction progress





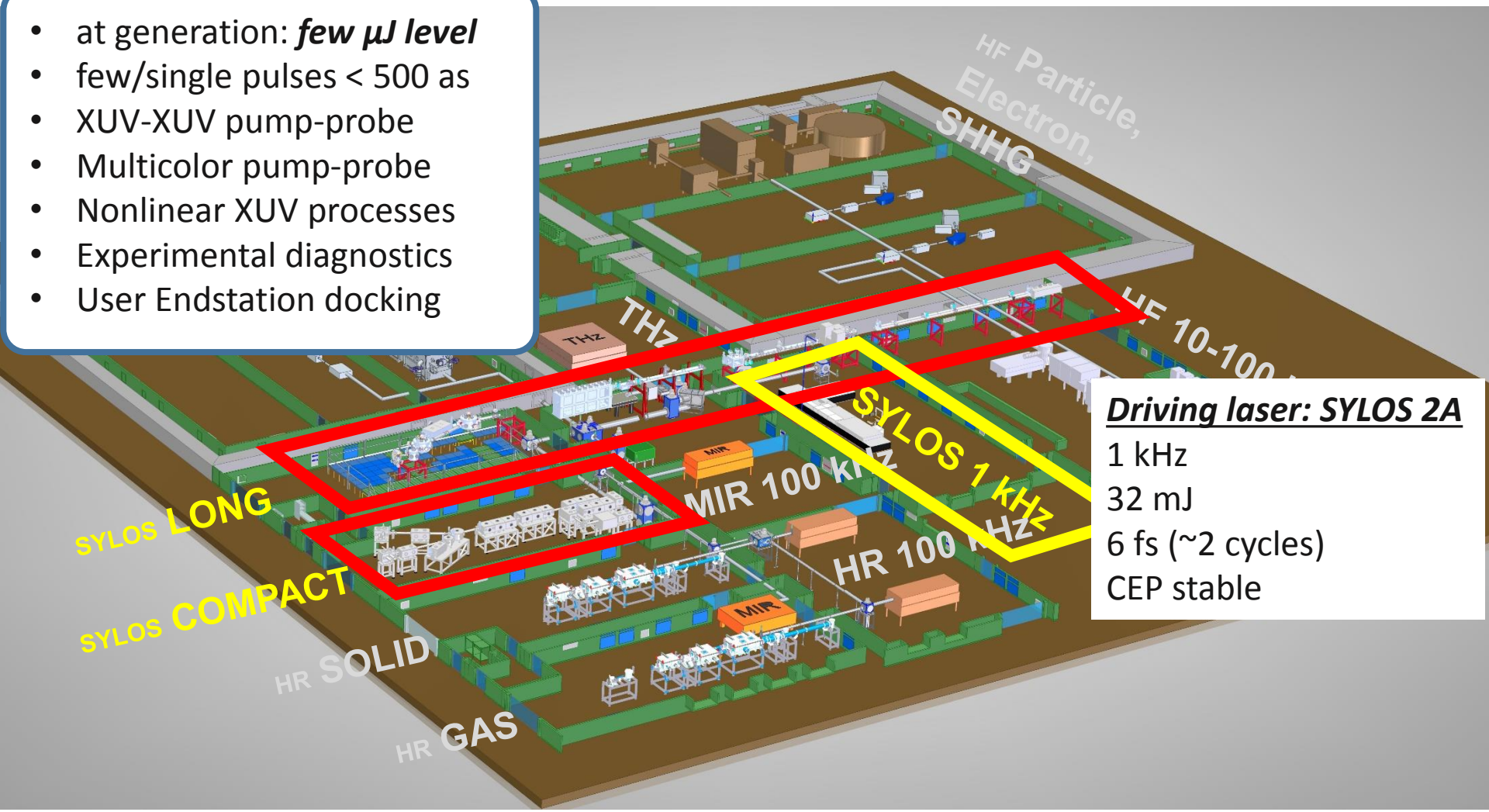
Vacuum ready

Finalizing vacuum



The SYLOS GHHG Beam Lines
Summary

- at generation: ***few µJ level***
- few/single pulses < 500 as
- XUV-XUV pump-probe
- Multicolor pump-probe
- Nonlinear XUV processes
- Experimental diagnostics
- User Endstation docking



Driving laser: SYLOS 2A
1 kHz
32 mJ
6 fs (~2 cycles)
CEP stable

IR femtosecond pulses → XUV/X-Ray attosecond pulses

THANK YOU FOR YOUR ATTENTION!

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