

INAUGURAL 10 PW LASER AND USERS SYMPOSIUM:

MOVING INTO UNCHARTERED TERRITORIES



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10 PW

► The first 10 PW laser pulse was shot through the entire ELI-NP laser system

- E4 Experimental Hall 100 TW
- E5 Experimental Hall 1 PW
- E1 Experimental Hall 2x 10 PW
- E6 Experimental Hall 2x 10 PW



ELI-NP

► Is going to be the most advanced research facility in the world focusing on the study of photonuclear physics and its applications

01

Overview

ELI-NP, the Nuclear Physics pillar of the European distributed infrastructure ELI, is going to be the most advanced research facility in the world focusing on the study of photonuclear physics and its applications, comprising a very high intensity laser of two 10 PW ultra-short pulse lasers.

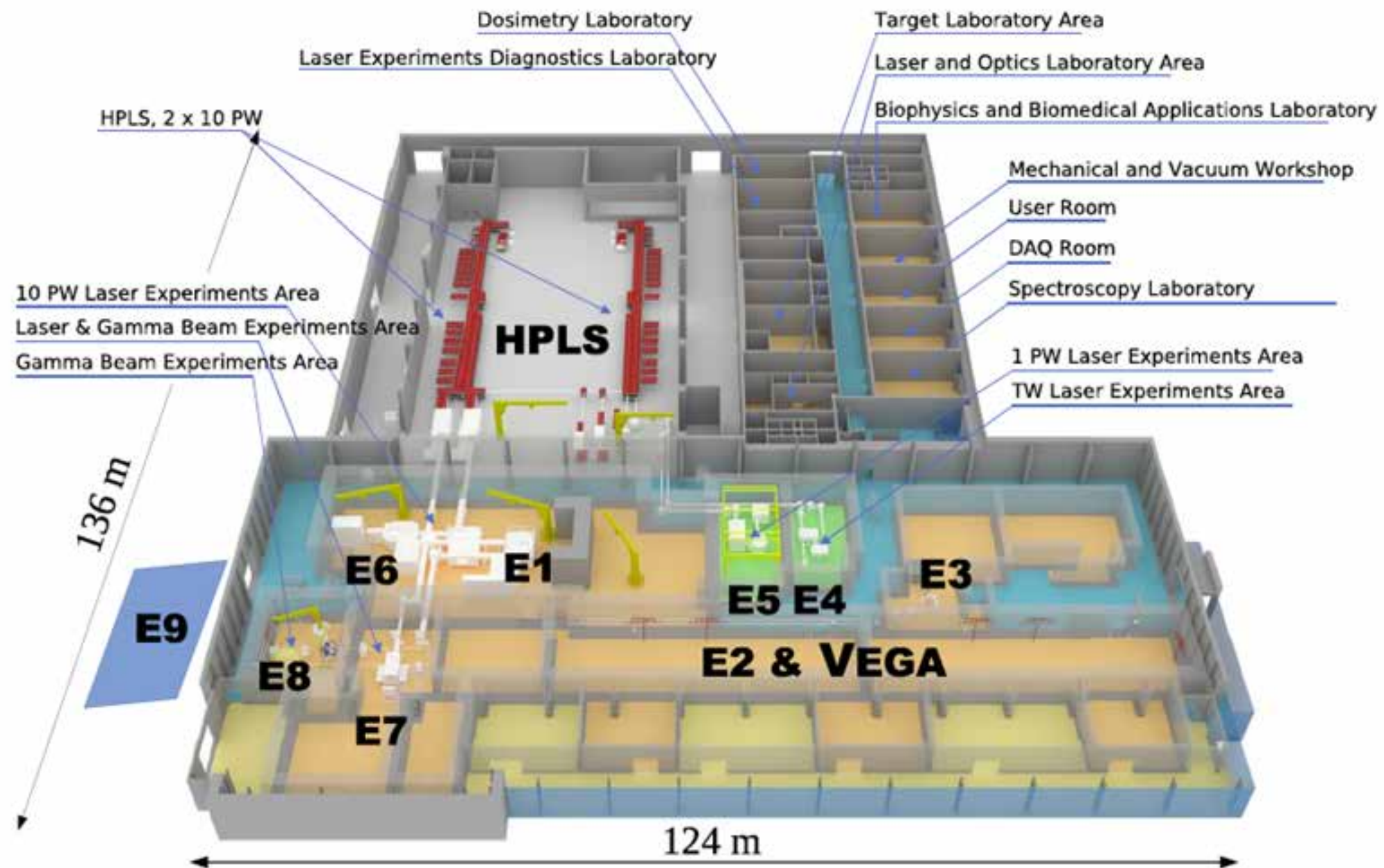
This unique experimental combination will enable ELI-NP to tackle a wide range of research topics in fundamental physics, nuclear physics, and astrophysics, and also applied research in materials

science, management of nuclear materials and life sciences.

ELI-NP has been selected by the most important scientific committees in Nuclear Physics in Europe - NUPECC - in the Nuclear Physics Long Range Plan in Europe as a major facility.

02

Building layout



10 PW

► The first 10 PW laser pulse was shot through the entire ELI-NP laser system



03

Status

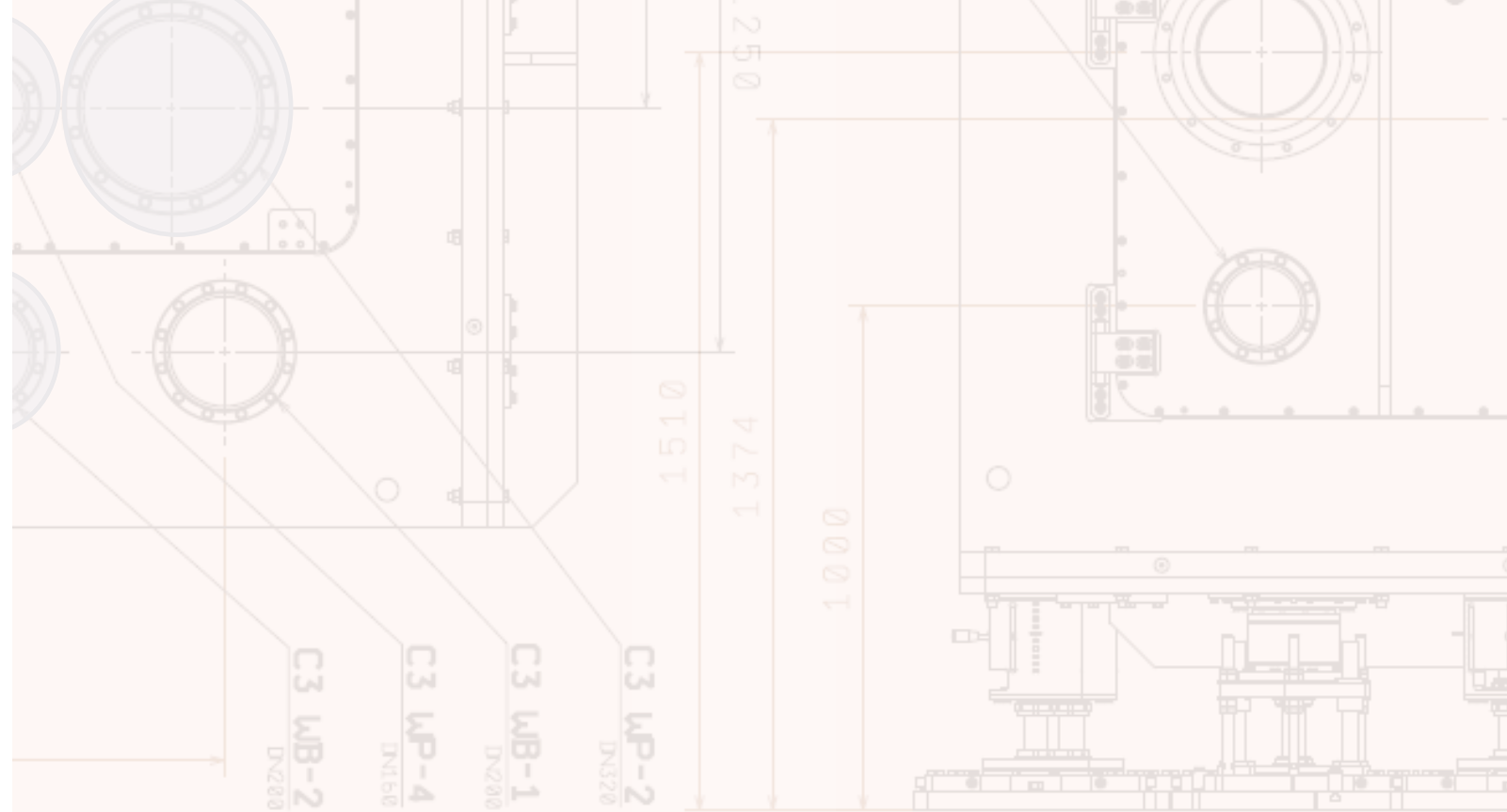
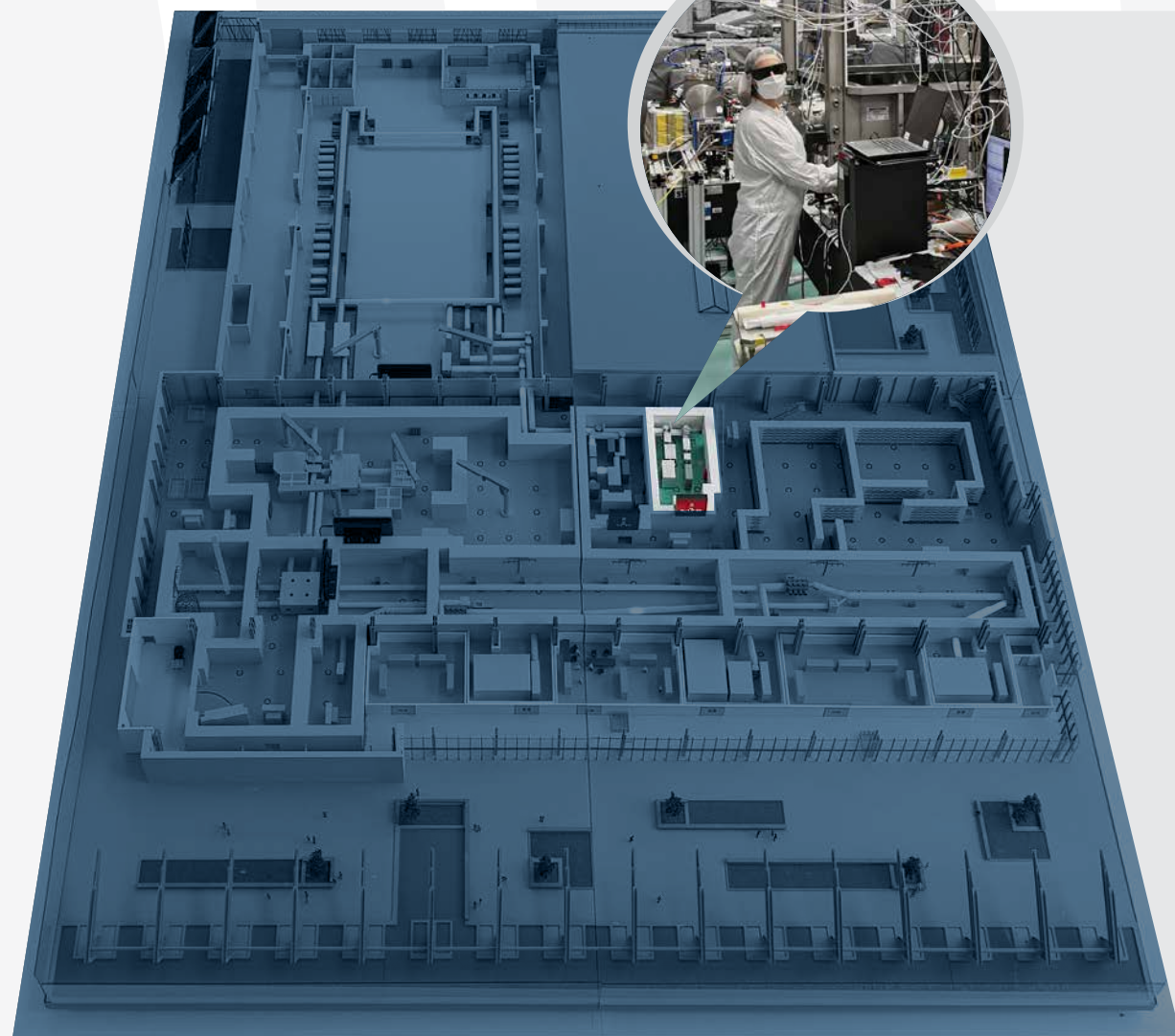
On the 19th of August 2020, the first 10 PW laser pulse was shot through the entire ELI-NP laser system, namely all the amplifiers, the final compressor, the 30 m of the beam transport system and finally into a beam dump. During this test the High Power Laser System (HPLS) fired 10 shots at 3 PW, 10 shots at 7 PW, 3 shots at 8 PW, and 10 shots at 10 PW; so one shot/minute over a period of about 40 minutes, thus demonstrating the robustness of the laser system. The energy fluctuation between shots was less than 2% and there was good pointing stability, namely an average fluctuation of the beam direction corresponding to less than 3 mm after one kilometer of propagation.

Preliminary experiments have begun in March 2020 for the 100 TW arm of the laser system and for the 1 PW energy pulses, plans to test proton acceleration are scheduled to take place before the end of 2020. The more challenging 10 PW beams commissioning experiments are planned to take place in 2021, where the laser beams are focused down to several microns, thus putting more than 10^{22} W/cm² on target.



E4

E4 Experimental Hall 100 TW



► Designed Specifications:

Shot rate: 10 shot/second
Energy: 3 mJ-2.5 J
Focusing optic: f/8, f/25
Intensity on target: 10^{19} W/cm²
Central Wavelength: 814-825 nm
Pulse Duration: 25 fs

► Available Diagnostics & Equipment

- Electron Spectrometers
- Optical Spectrometers
- X-ray imaging

Probe Beam:
Energy: to be determined

► Status:

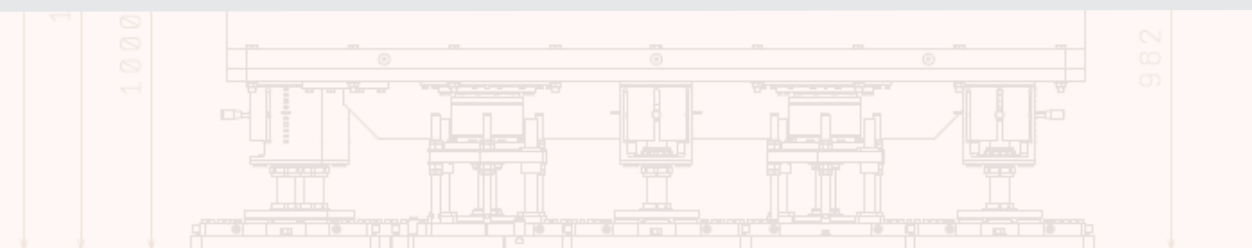
Installation:



Commissioning:

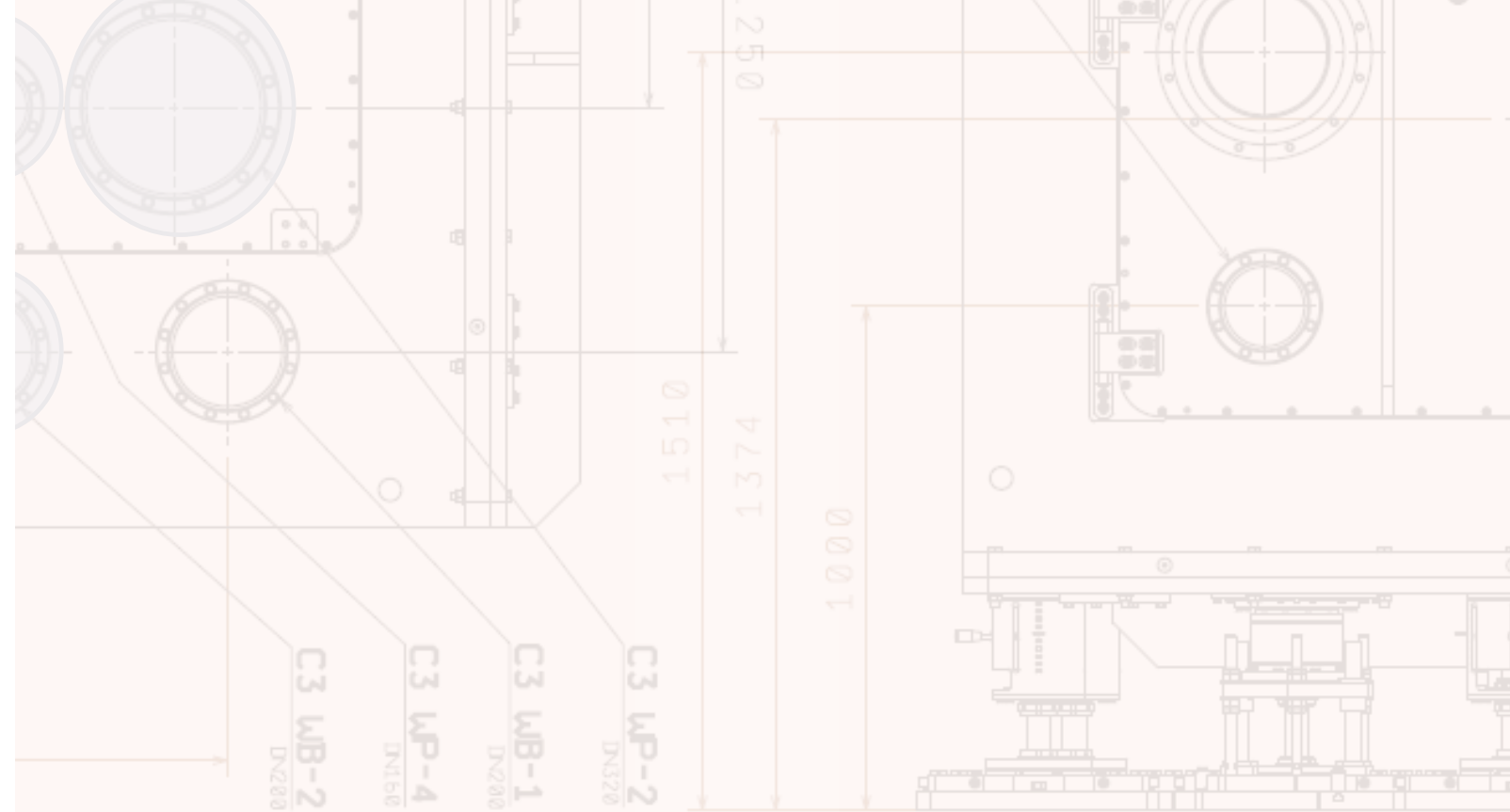
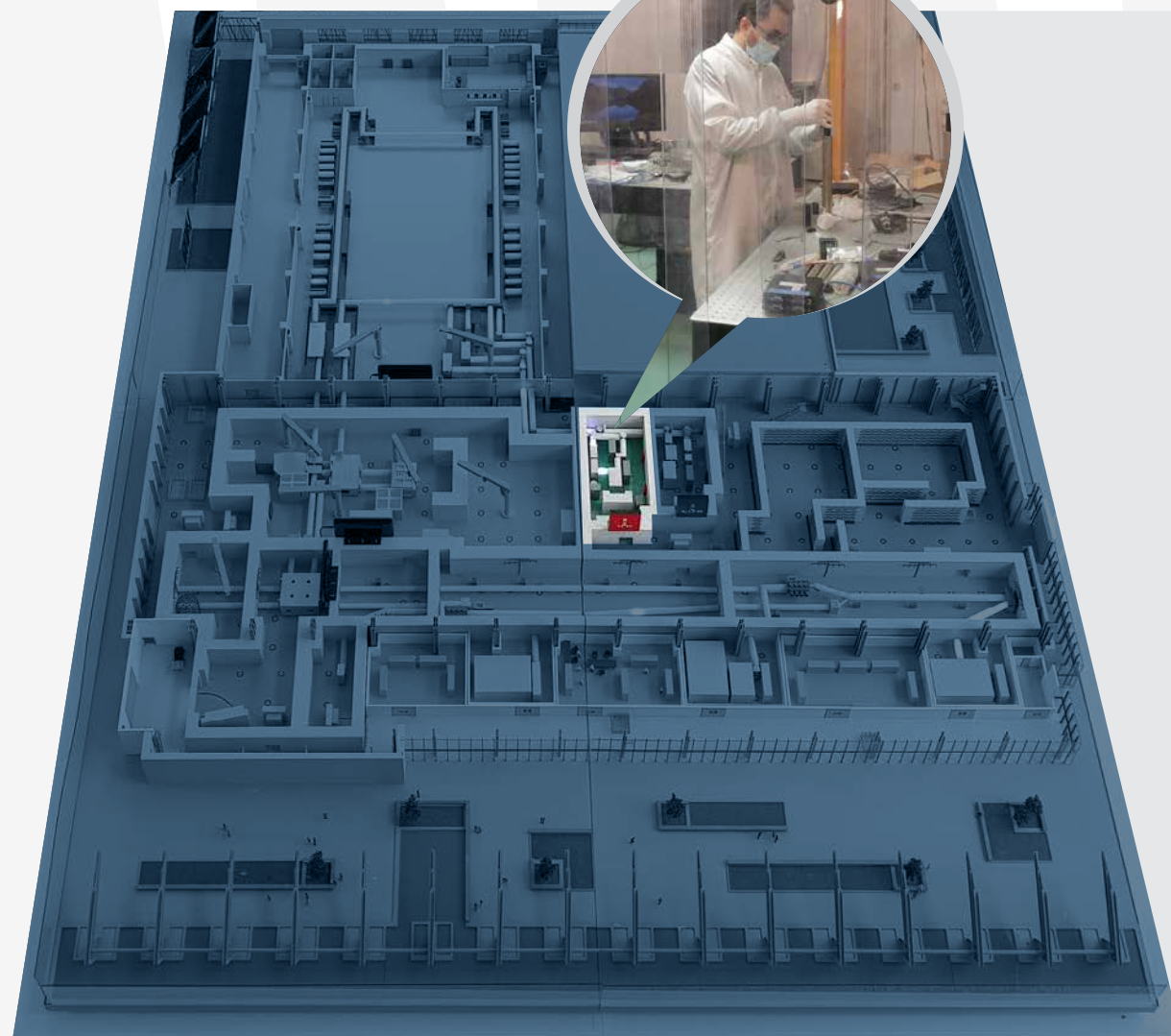


Open to Users:



E5

E5 Experimental Hall 1 PetaWatt



► **Designed Specifications:**

Shot rate: 1 shot/second
 Energy: 15-25 J each beam
 Focusing optic: f/3.5, f/24
 Intensity on target: 10^{21} W/cm²
 Central wavelength: 814-825 nm
 Pulse Duration: 24 fs
 Frequency double: Yes

Probe Beam:

Energy: 1-50 mJ
 Frequency double: Yes

► **Available Diagnostics & Equipment**

- Thomson Parabola (up to 100 MeV)
- Electron & Positron Spectrometers (up to 100 MeV)
- Gamma Spectrometer (5-50 MeV)
- Streak Cameras (visible, NIR)
- CsI(Tl) spectrometer (up to 20 MeV)
- Activation with coincidence counters

► **Status:**

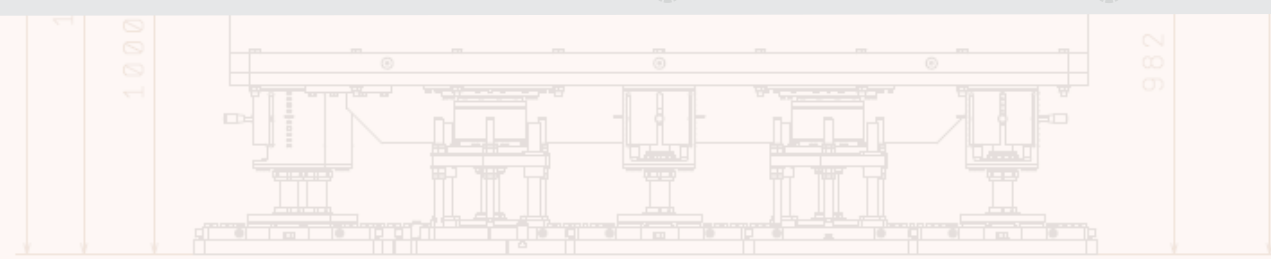
Installation:



Commissioning:

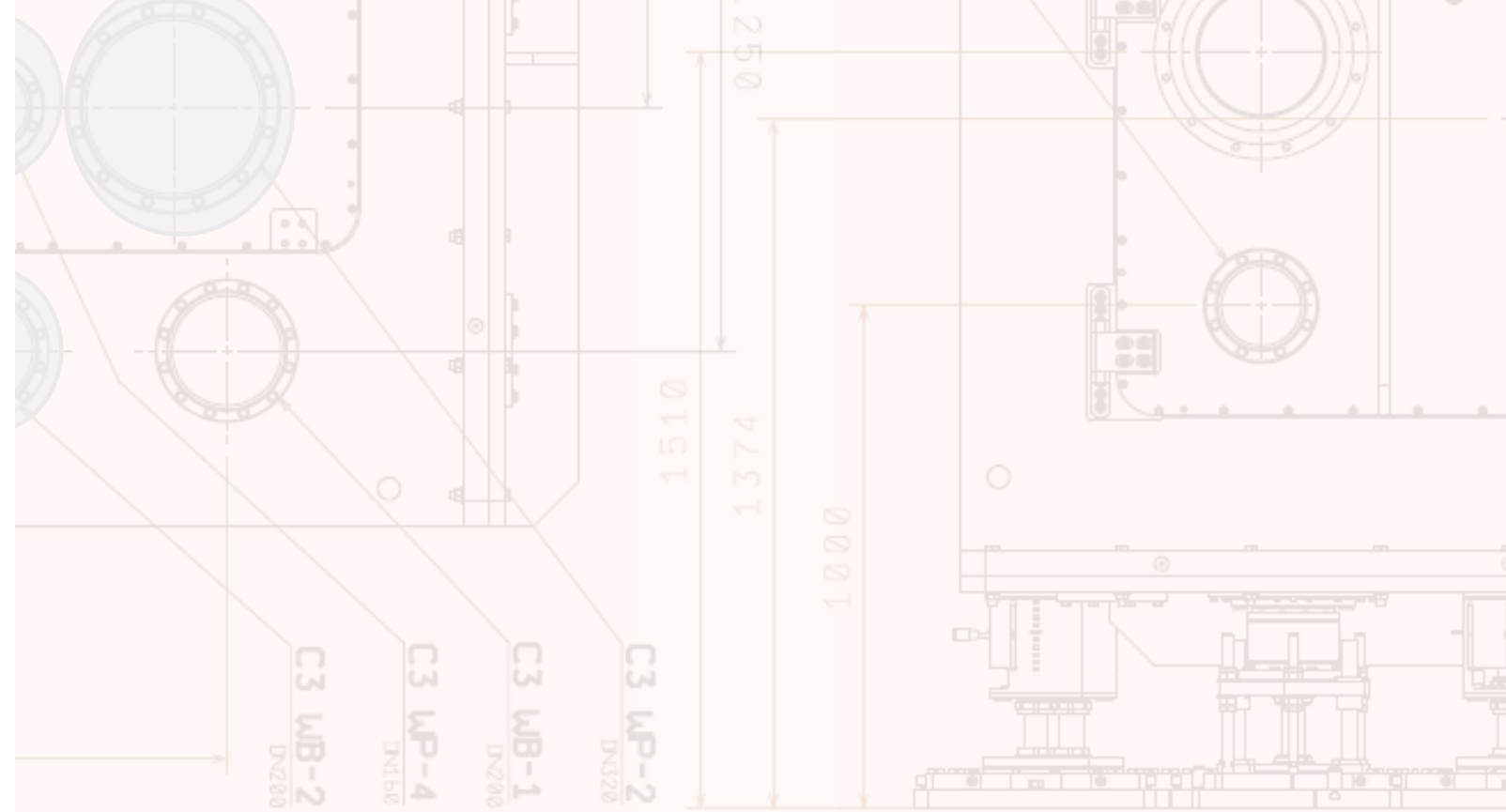
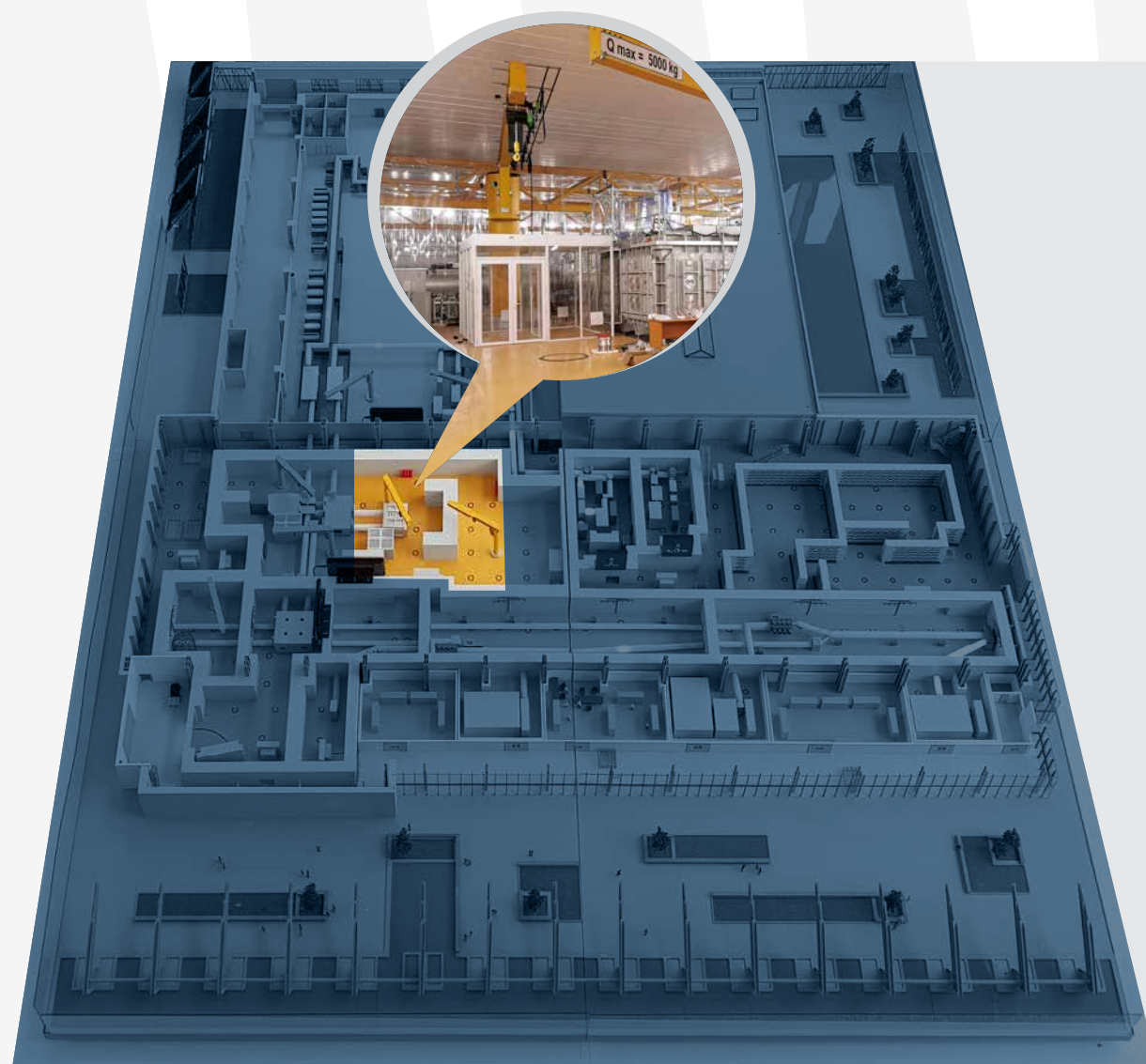


Open to Users:



E1

E1 Experimental Hall 2 x 10 PetaWatt



► **Designed Specifications:**

Shot rate: 1 shot/minute
 Energy: 230 J each beam
 Focusing Optic: f/2.7
 Intensity on target: 10^{22} W/cm²
 Central wavelength: 814-825 nm
 Pulse Duration: 23 fs
 Frequency double: Yes

Probe Beam:

Energy: 1-50 mJ
 Frequency double: Yes

► **Available Diagnostics & Equipment**

- Thomson Parabola (up to 250 MeV)
- Electron & Positron Spectrometers (up to 100 MeV)
- Gamma Spectrometer (5-50 MeV)
- Spectrometers (wavelength?)
- CsI(Tl) spectrometer (up to 20 MeV)
- Activation with coincidence counters

► **Status:**

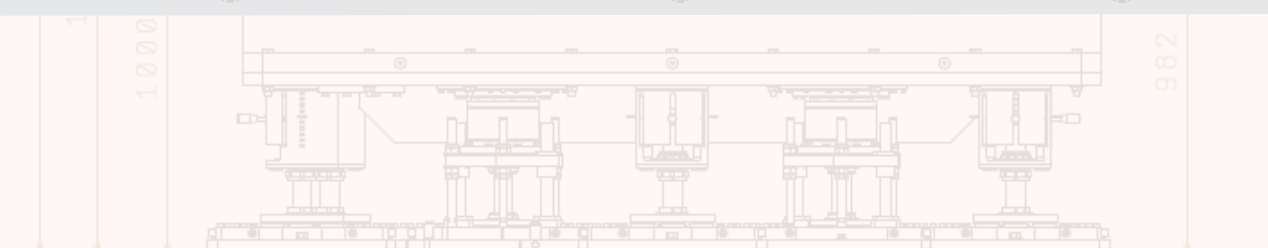
Installation:



Commissioning:

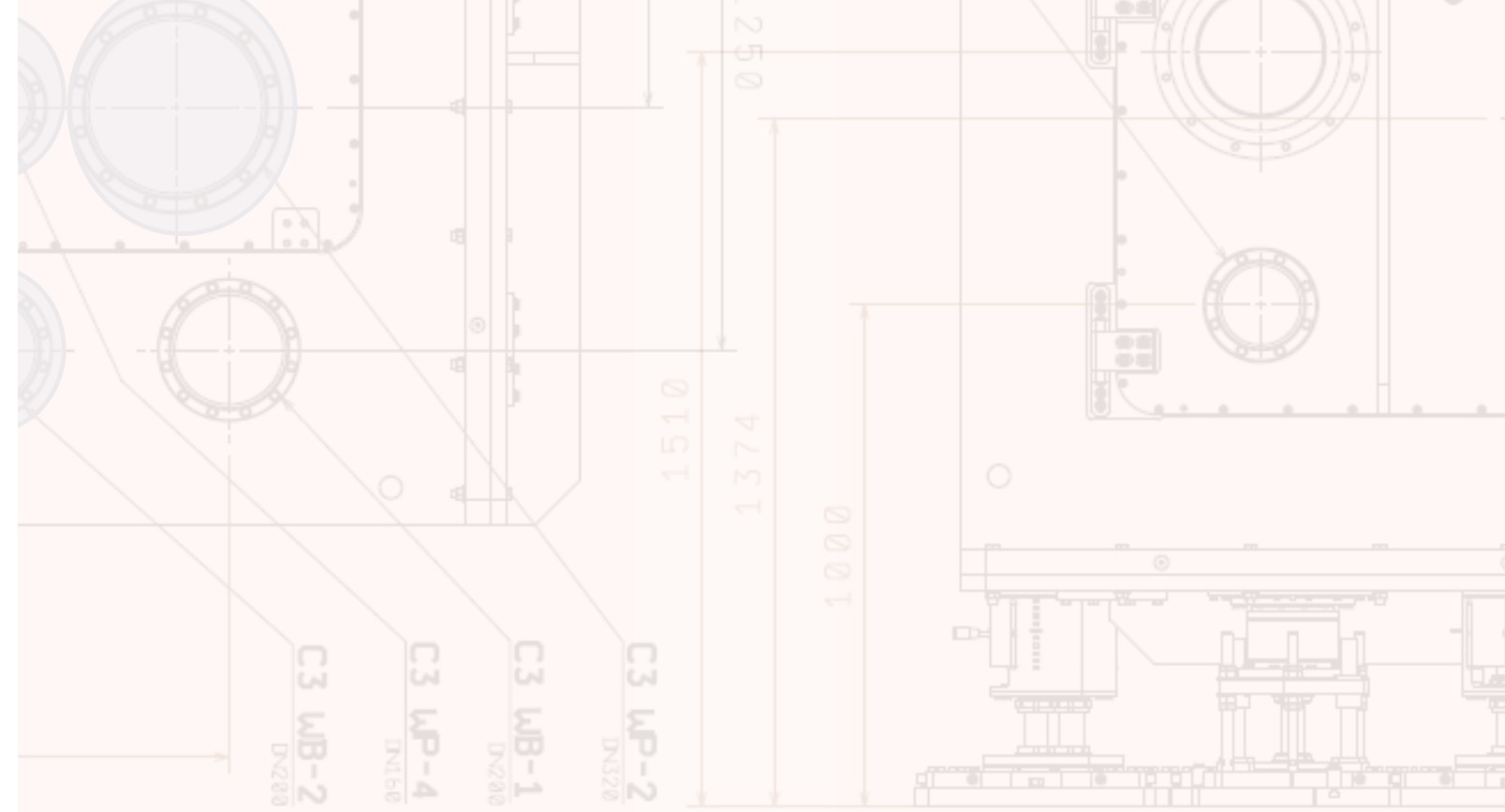
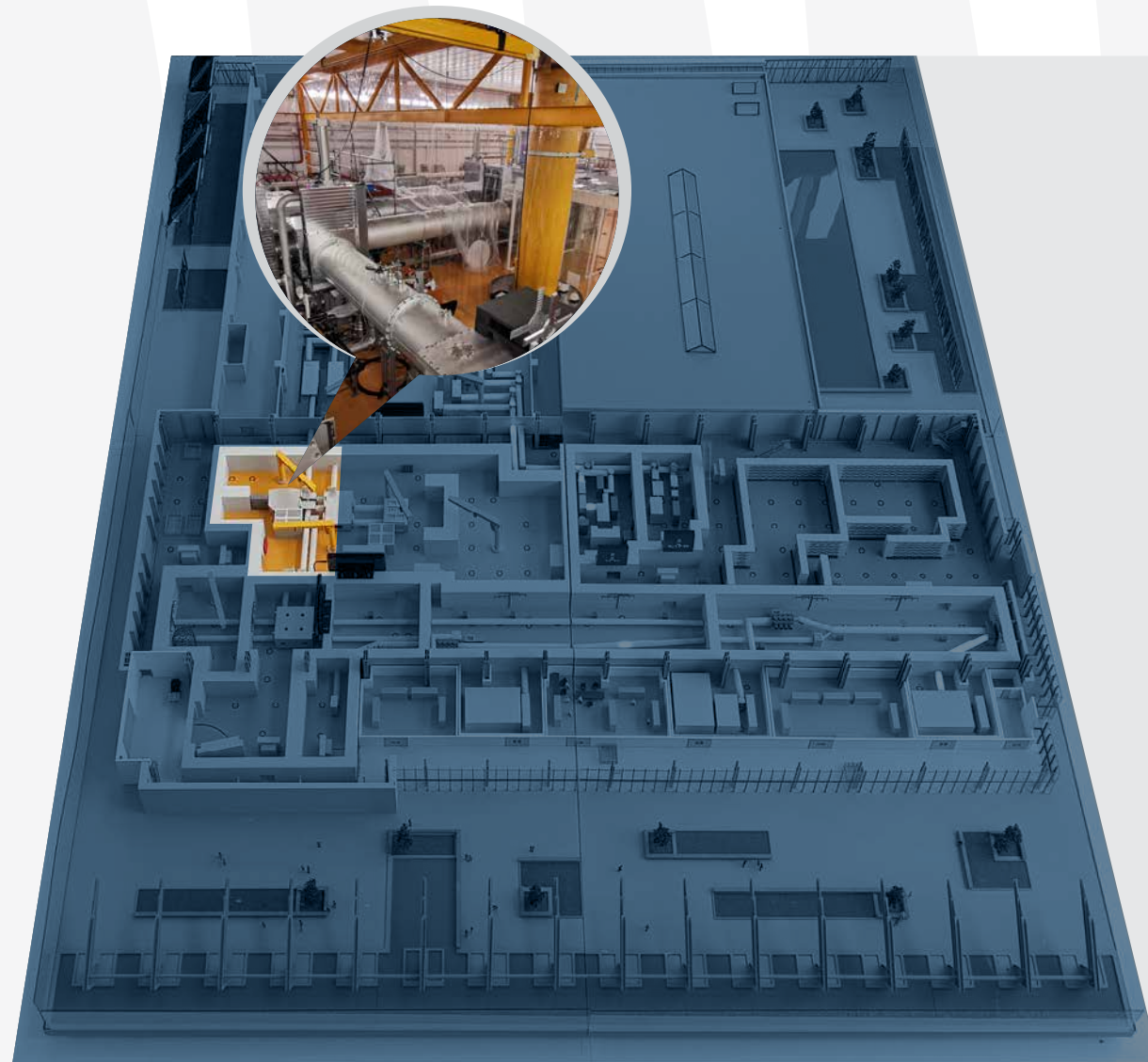


Open to Users:



E6

E6 Experimental Hall 2 x 10 PetaWatt



► Designed Specifications:

Shot rate: 1 shot/minute
 Energy: 230 J each beam
 Focusing Optic: f/54
 Intensity on target: 10^{20} W/cm²
 Wavelength: 814-825 nm
 Pulse Duration: 15-22.5
 Frequency double: Yes

Probe Beam:

Energy: 1-50 mJ
 Frequency double: Yes

► Available Diagnostics & Equipment

- Electron Spectrometers (up to 5 GeV)
- Optical Spectrometers

► Status:

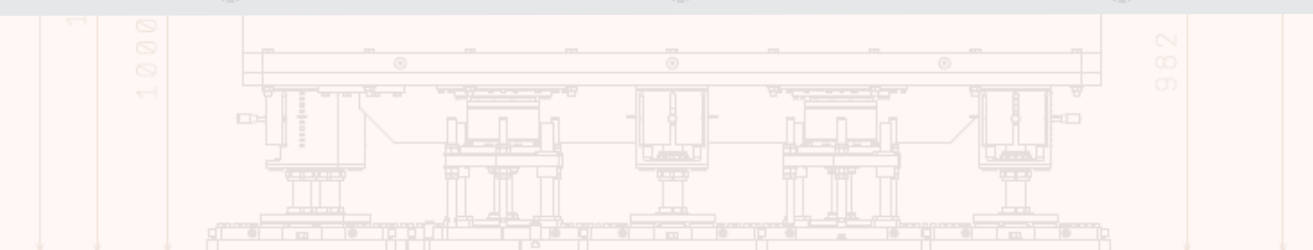
Installation:



Commissioning:



Open to Users:



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Participants

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