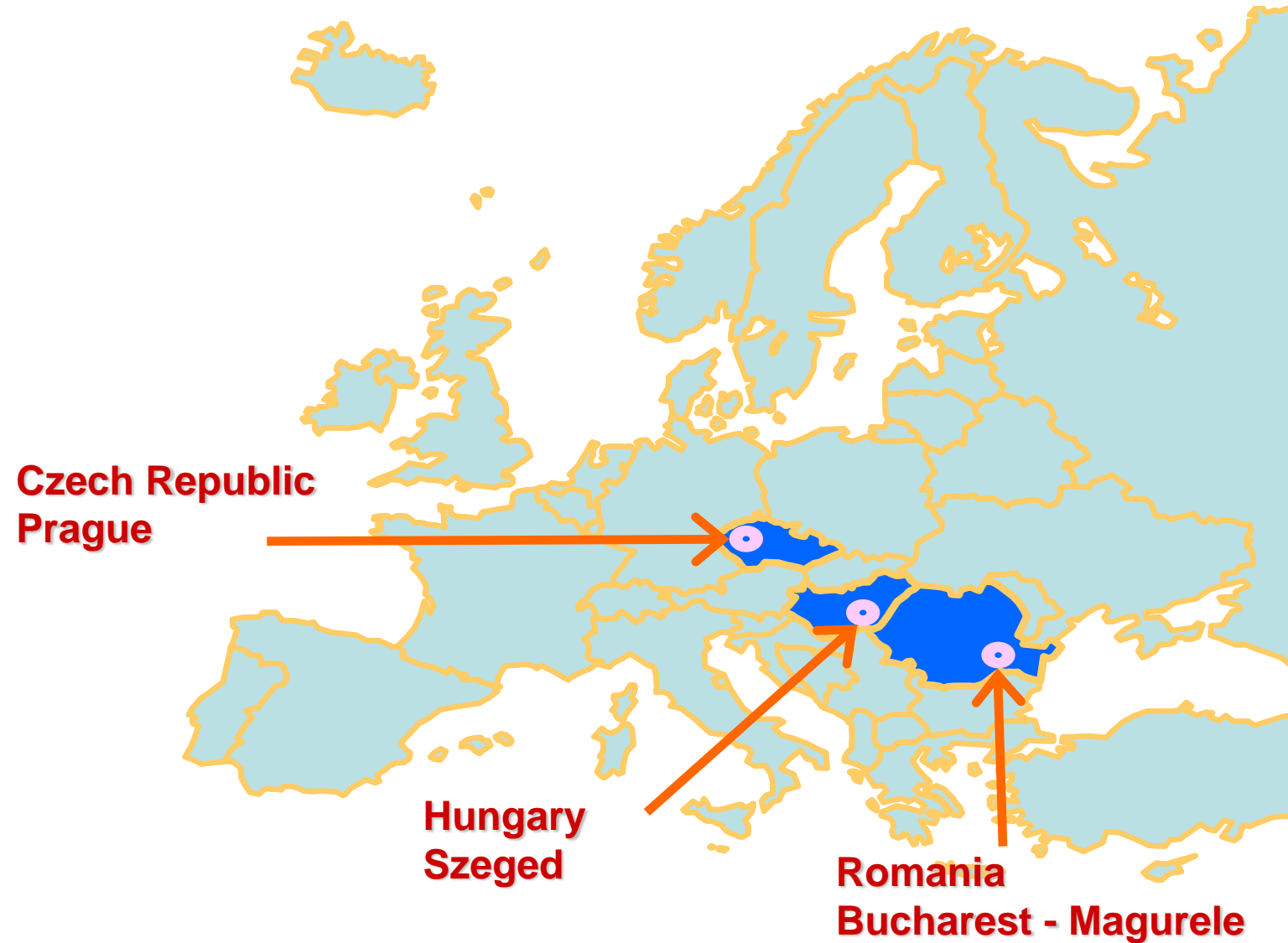


Extreme Light Infrastructure (ELI) Science and Technology at the ultra-intense Frontier

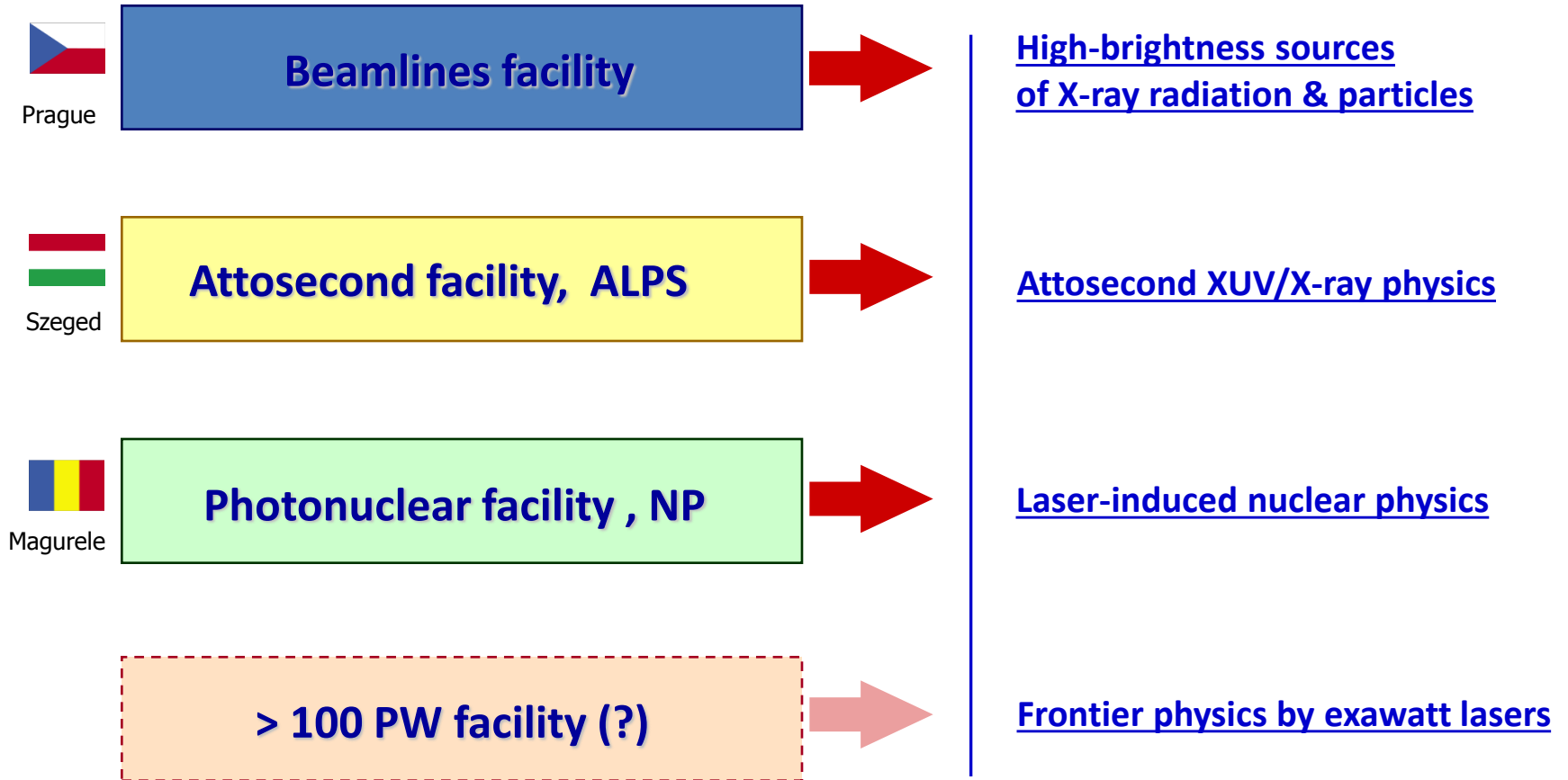
Prof. Bruno Le Garrec
bruno.legarrec@eli-beams.eu

**On behalf of Dr. Georg Korn (georg.korn@eli-beams.eu) and the ELI-Beamlines team
Institute of Physics v.v.i., Prague
Czech Republic**

Site selection: decision on 1.10.2009



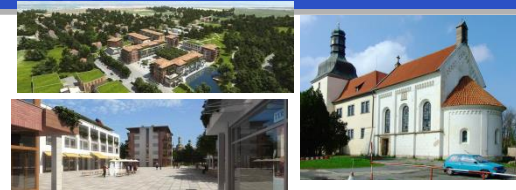
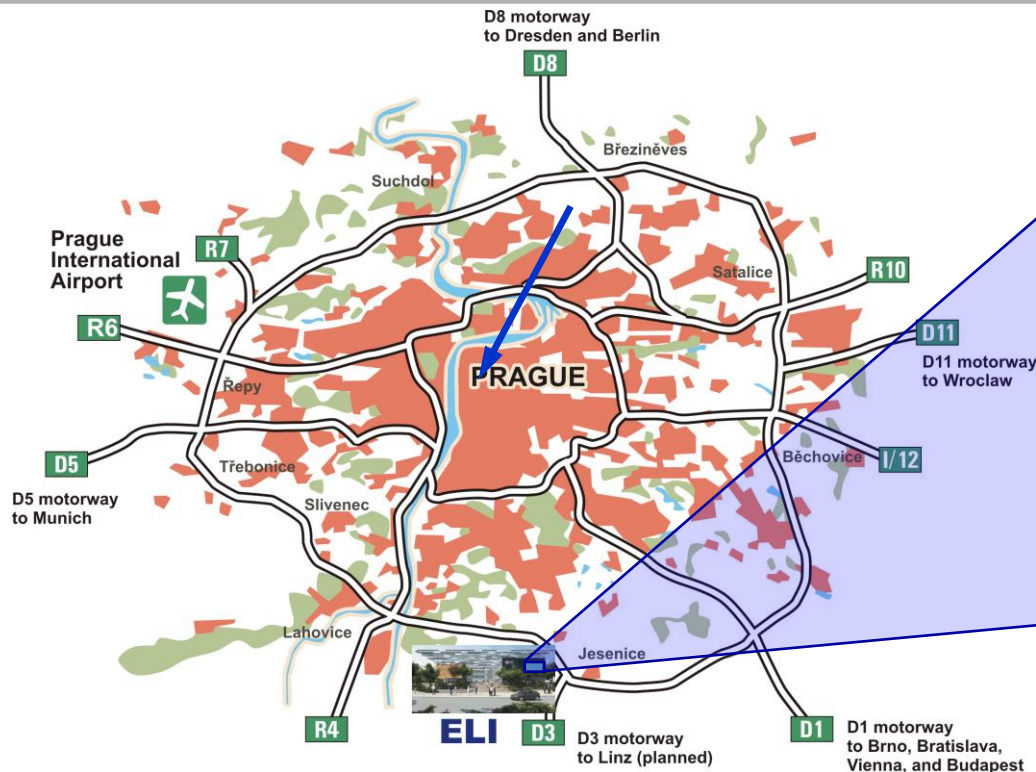
Structure of implementation of the ELI project



ELI-Beamlines location: South of Prague

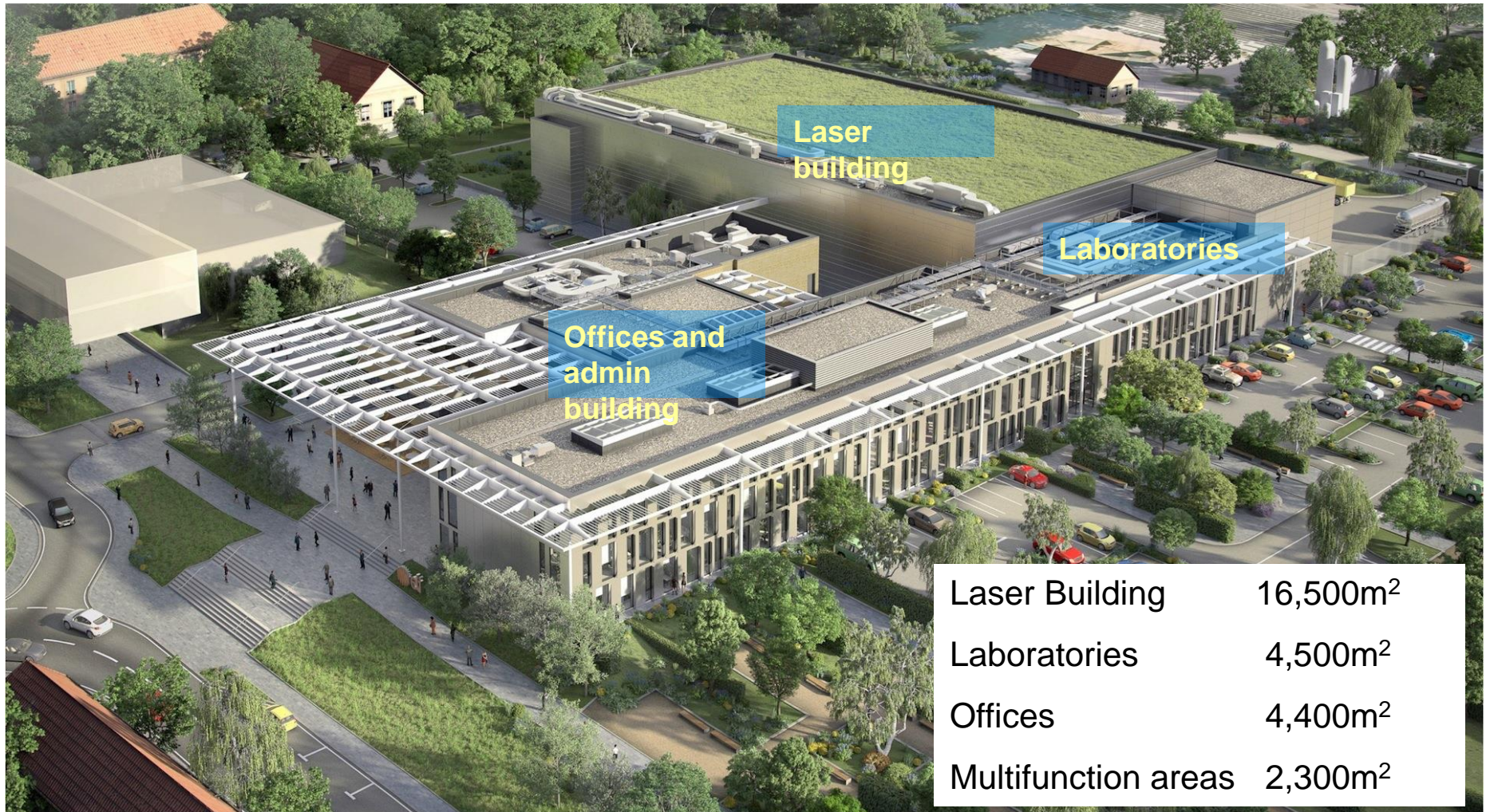


Groundbreaking ceremony happened



- Proximity of international airport (15 min drive), enjoyable surroundings, behind the border of Prague (funding issues)
- Synergy with planned large biotechnology center BIOCEV (2 km distance)
- Direct connection to Prague outer ring and the European motorway network

ELI-Beamlines facility view



ELI-Beamlines mission: fundamental & applied research

- High-repetition rate and high average power lasers using diode-pumping
- Ultra-high peak power of 10 PW, focused intensities up to 10^{24} Wcm⁻²

1. Generation of rep-rated femtosecond secondary sources of radiation and particles

- XUV and X-ray sources (monochromatic and broadband)
- Accelerated electrons (2 GeV 10 Hz rep-rate, 100 GeV low rep-rate),
protons (200-400 MeV 10 Hz rep-rate, >3 GeV low-rep-rate)
- Gamma-ray sources (broadband)

2. Programmatic applications of rep-rated femtosecond secondary sources

- Medical research including proton therapy
- Molecular, biomedical and material sciences
- Physics of dense plasmas, laser fusion, laboratory astrophysics

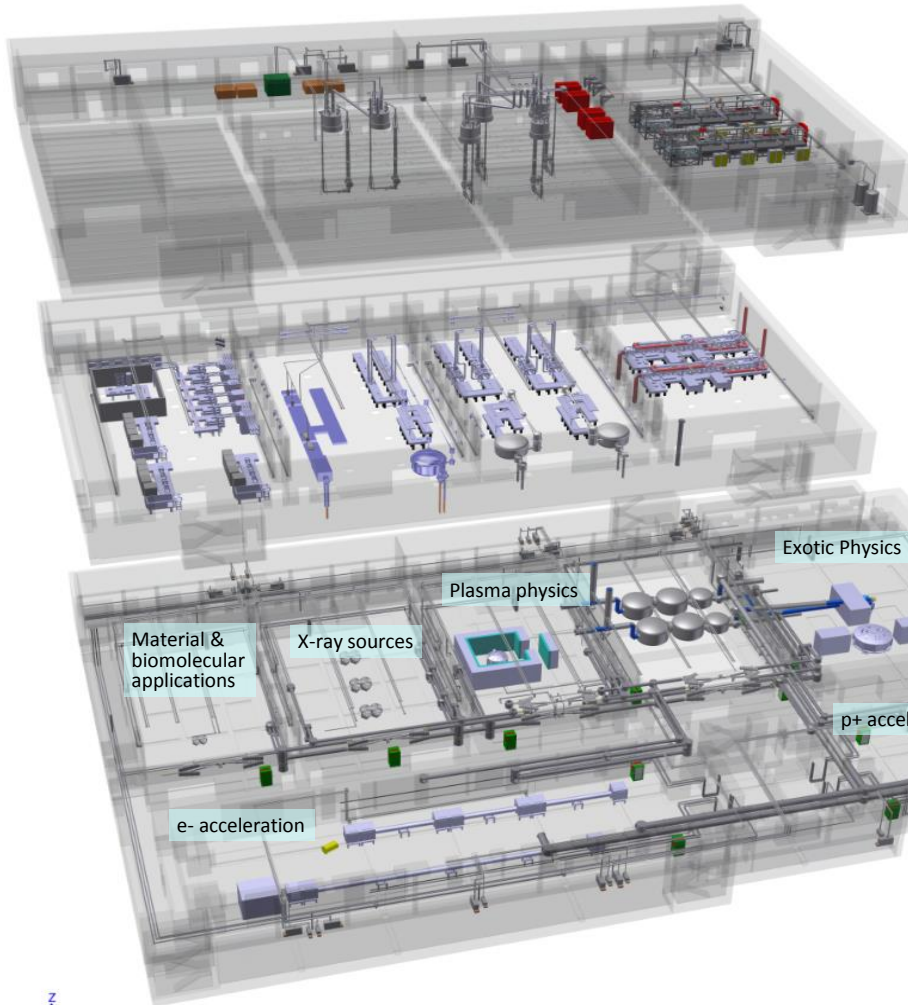
3. High-field physics experiments with focused intensities 10^{23} - 10^{24} Wcm⁻²

- “Exotic” physics, non-linear QED: sophisticated pump-probe capabilities

4. Development & testing new technologies for multi-PW laser systems

- Generation and compression of 10-PW ultrashort pulses, coherent superposition, etc.

Layout of ELI-Beamlines laser building



First floor (80 x 40 m)

kJ laser for L4

Support technologies, cooling systems, cryogenic systems

Ground floor (80 x 40 m)

4 laser halls (L1 to L4)

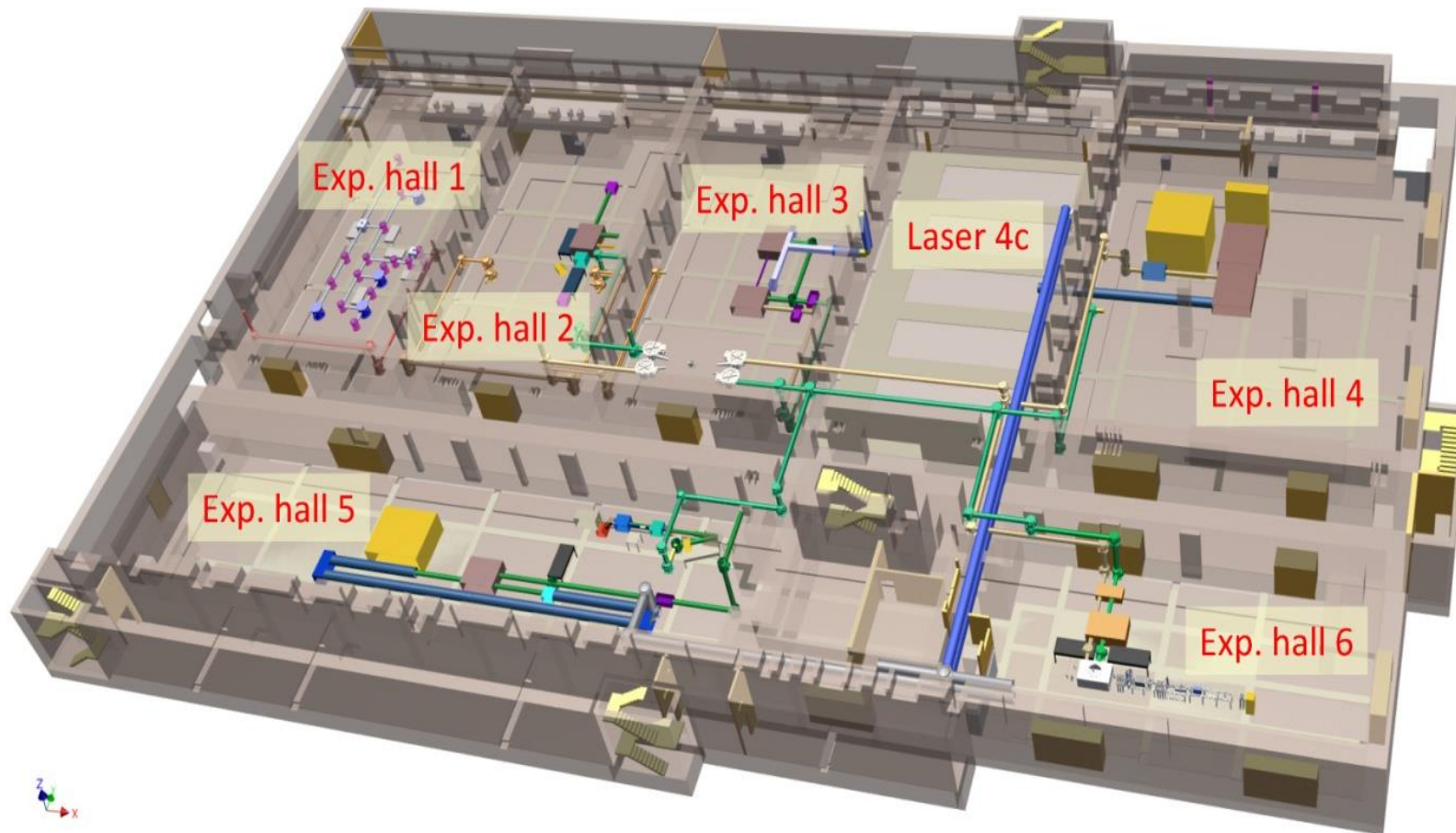
Basement (110 x 60 m)

Compressor(s) of L4 10-PW laser(s)

Vacuum pulse distribution

6 specialized experimental halls (E1 to E6)

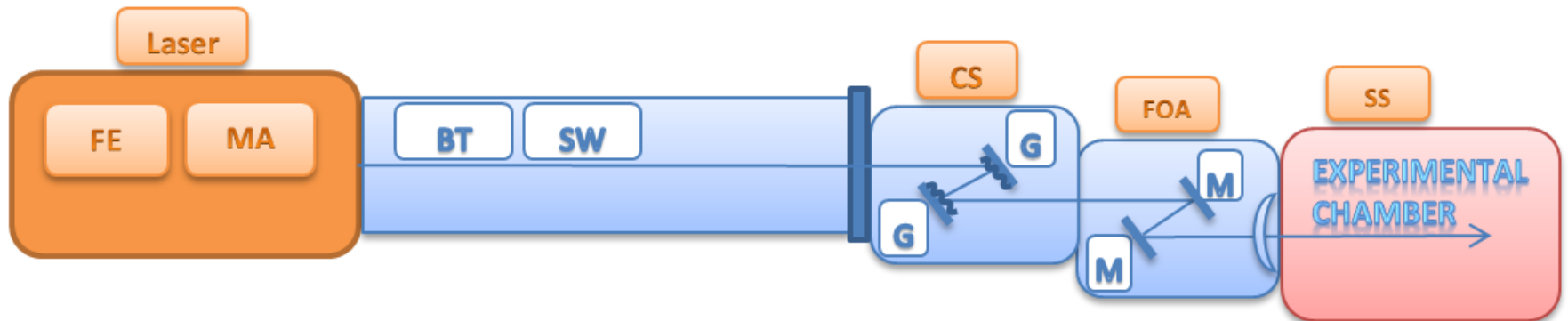
Experimental Area Ground floor



ELIMED

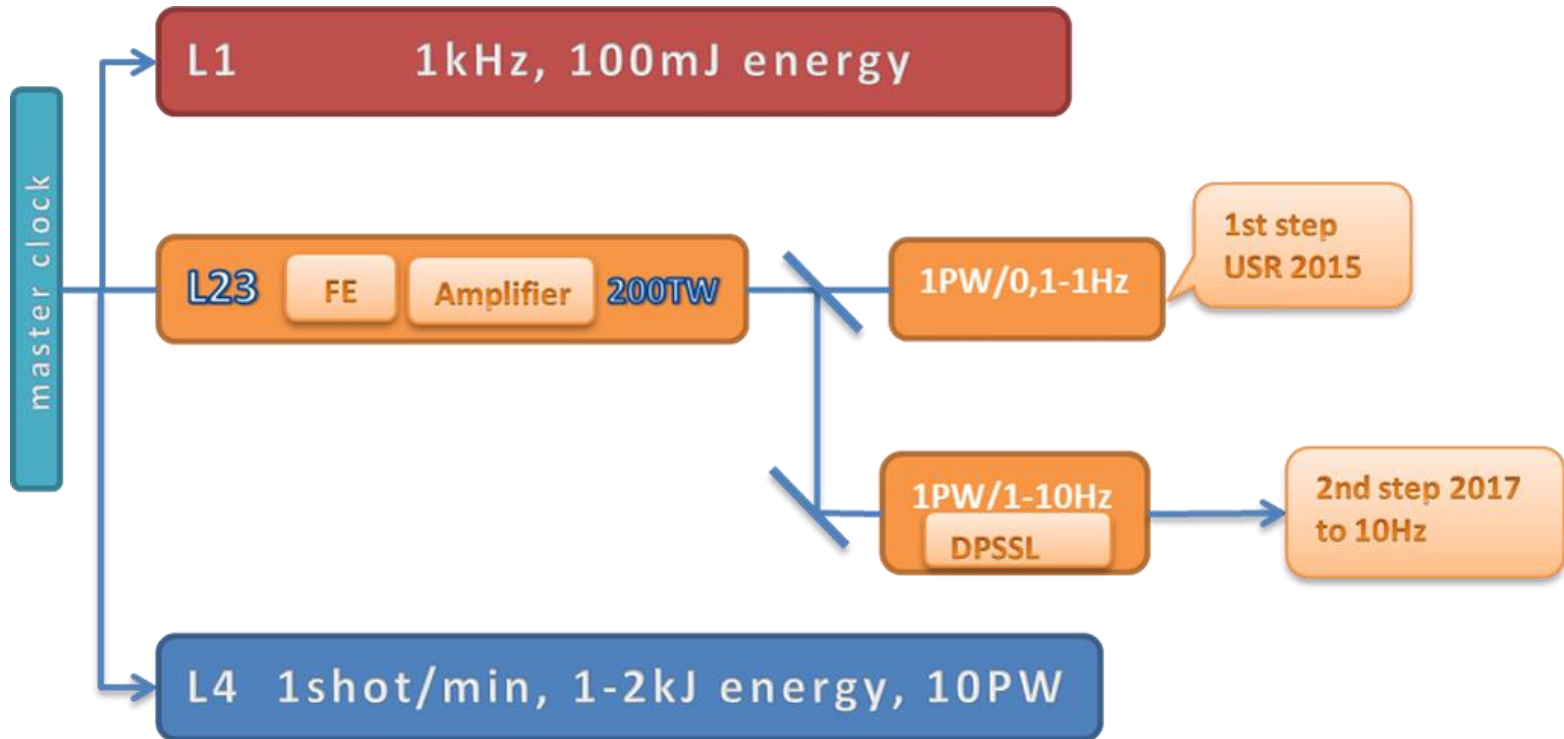
Underpinning laser technologies for ELI

Implementation of ELI

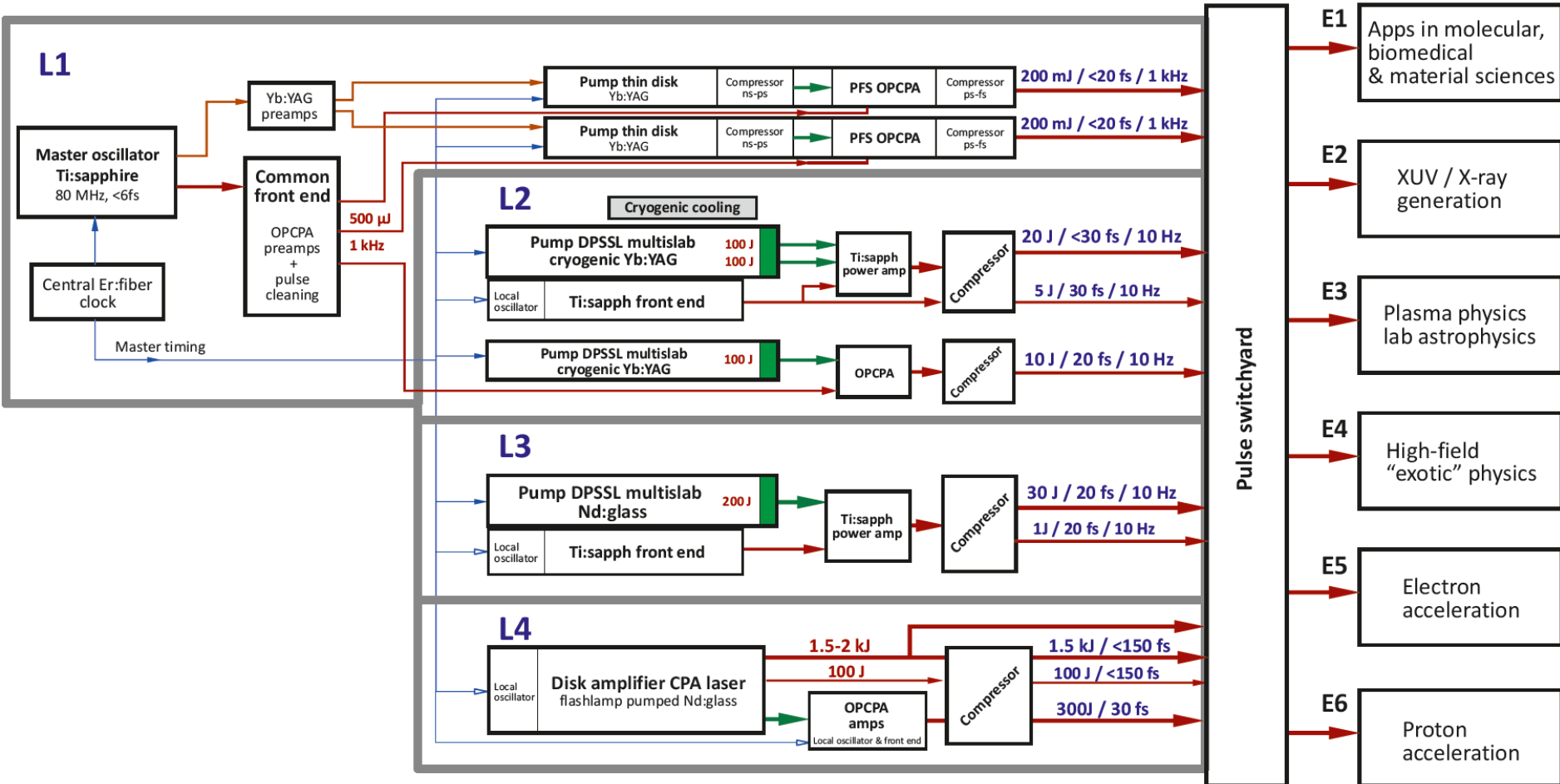


FE - front end
MA - main amplifier
BT - beam transport section
SW - switch yard
CS - compressor stage
FOA - final optics assembly
SS - secondary sources

Implementation of ELI



ELI-Beamlines laser scheme



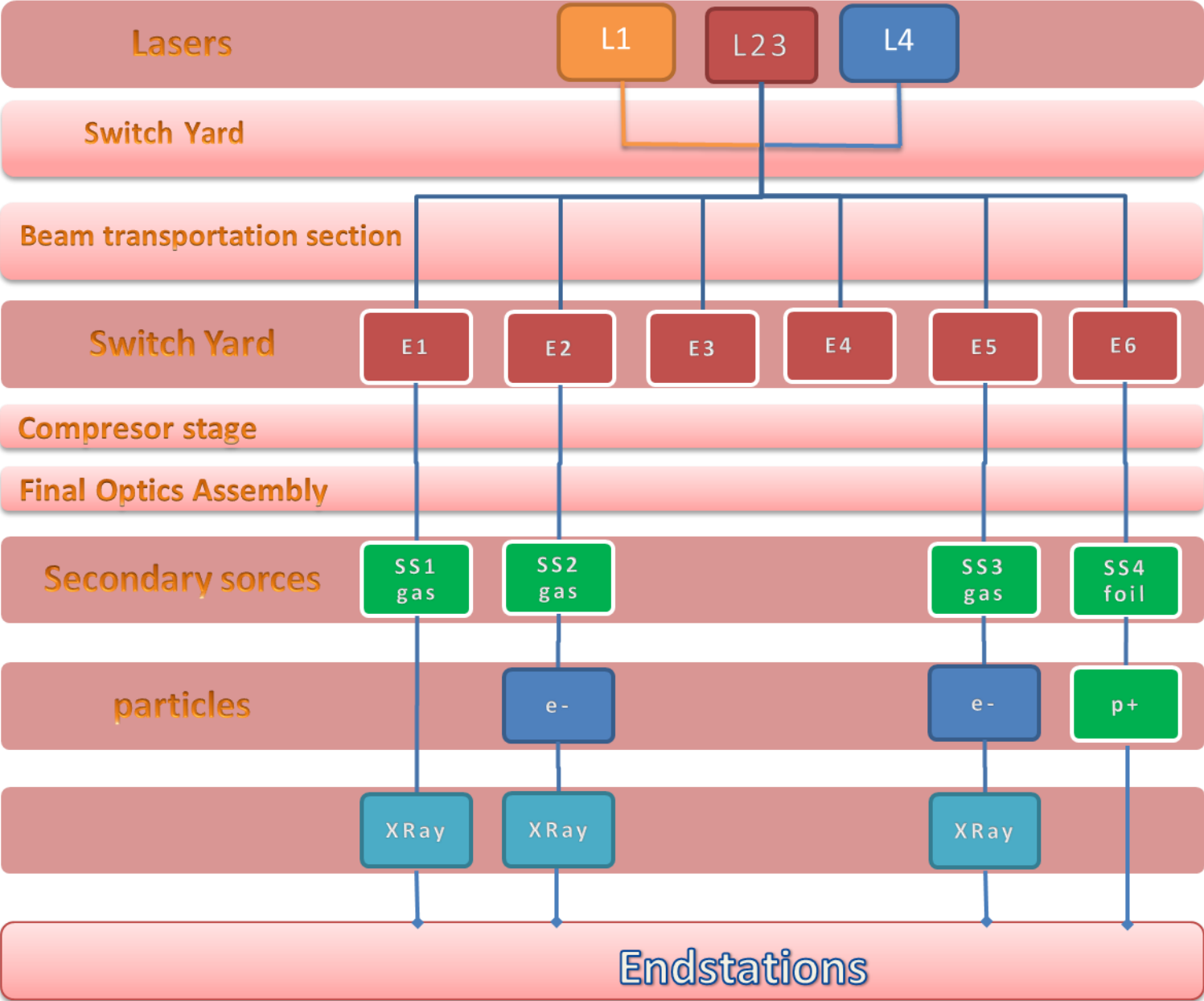
Secondary sources and beamlines, applications

based on intense laser plasma interaction
and connected with it acceleration of particles

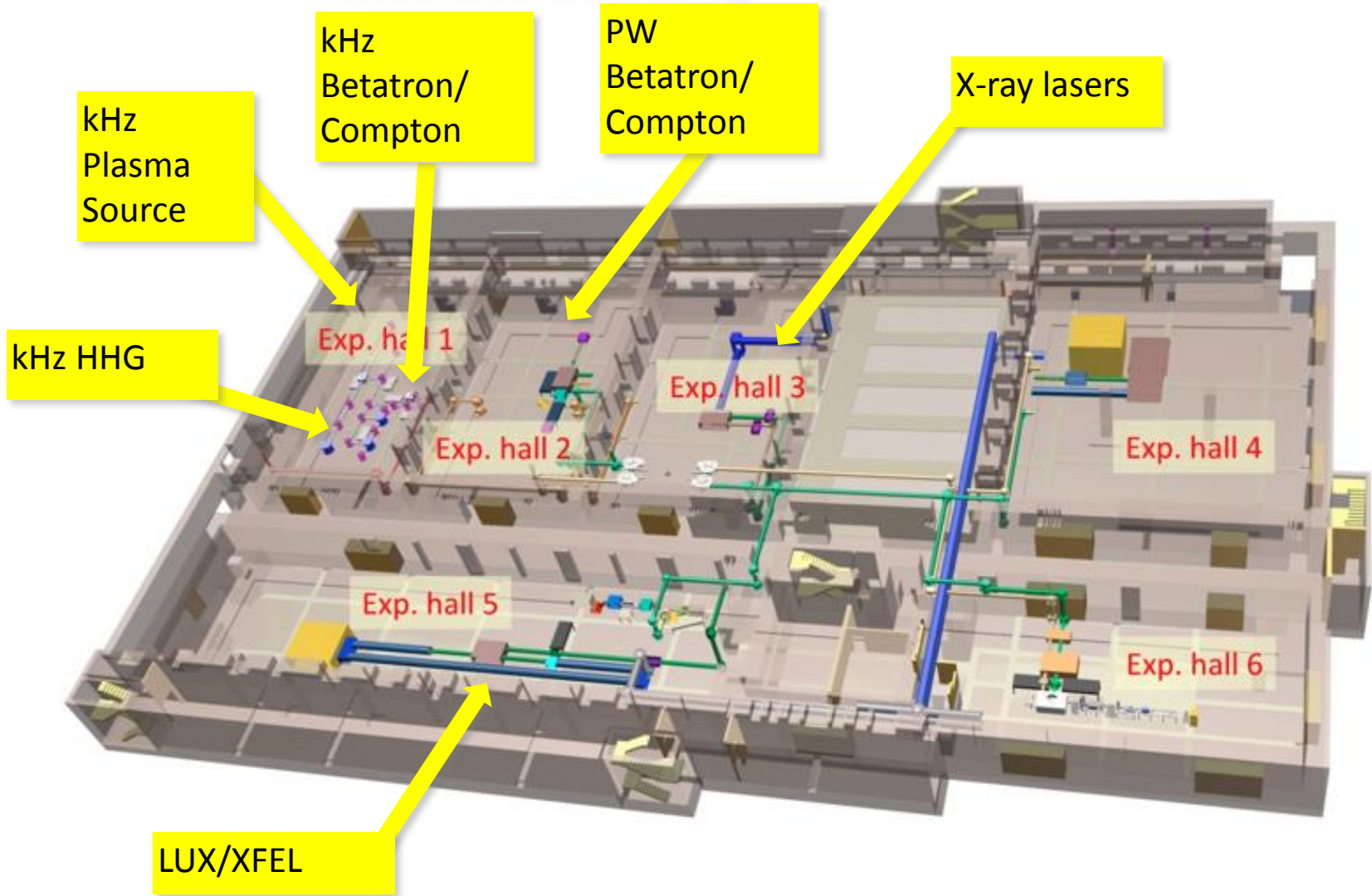
Secondary effects of electron acceleration:

X-rayBeam

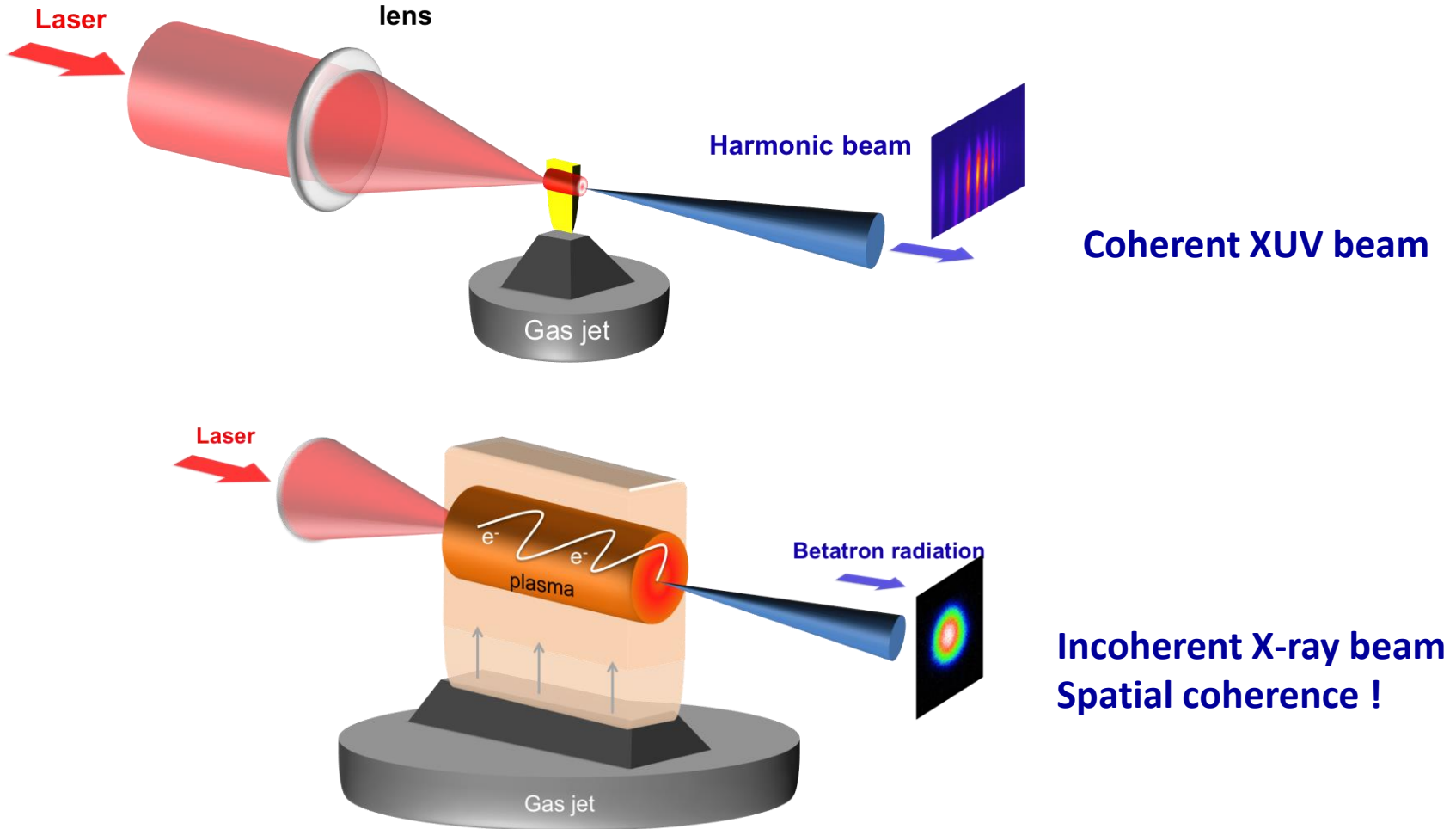
(compact laser driven X-FEL, betatron radiation,..)



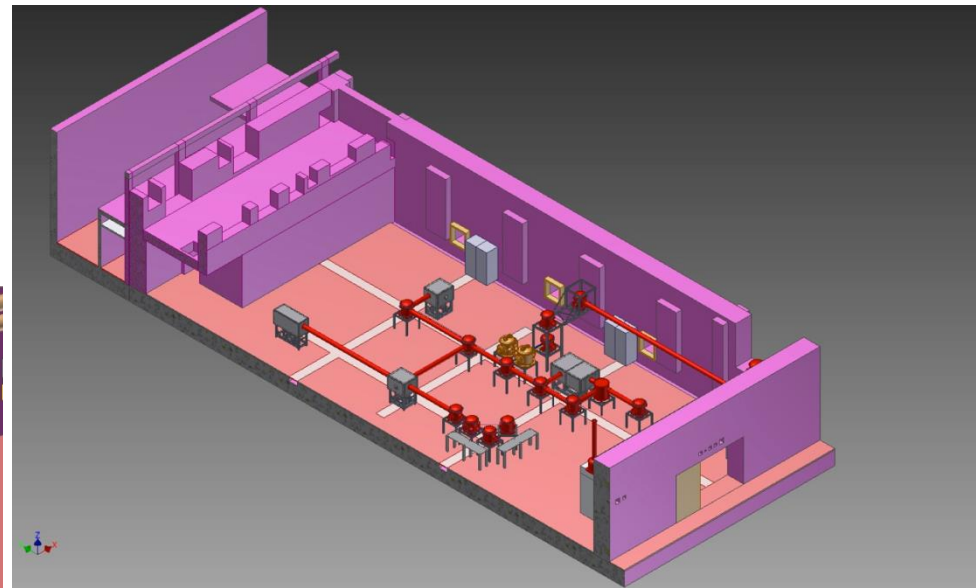
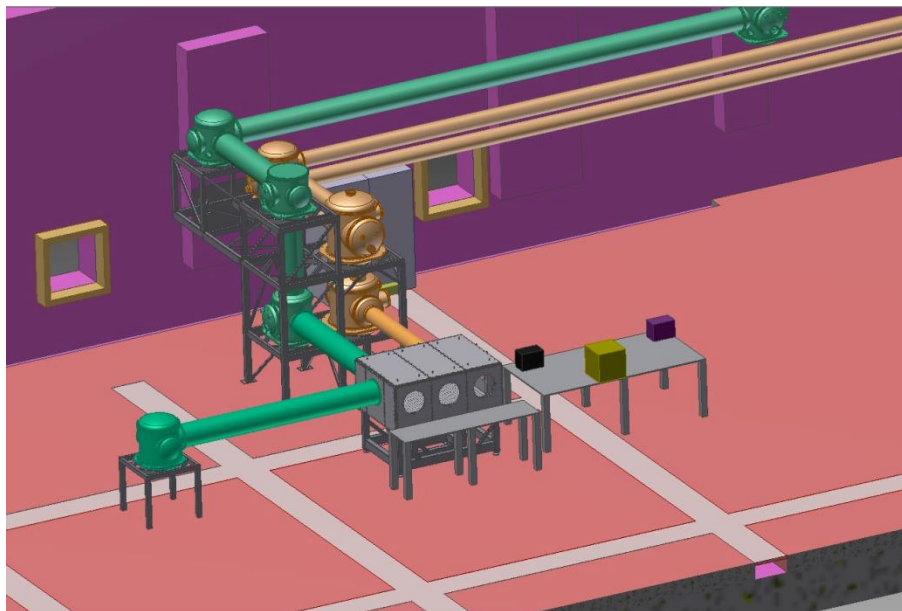
Implementation of x-ray beamlines into the building



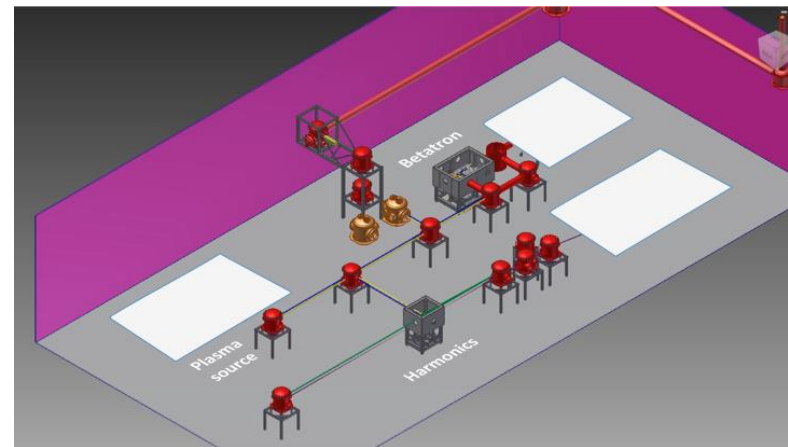
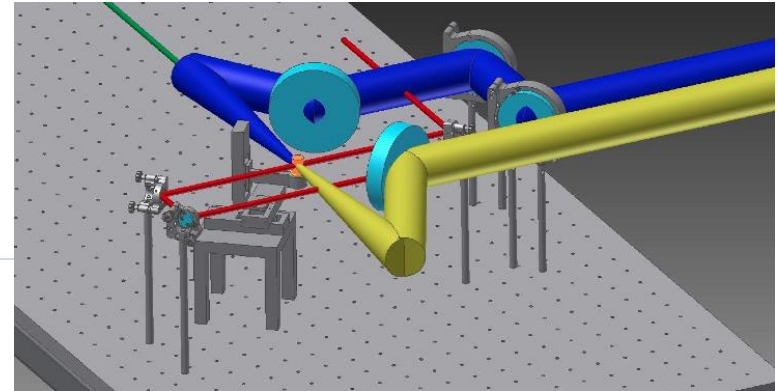
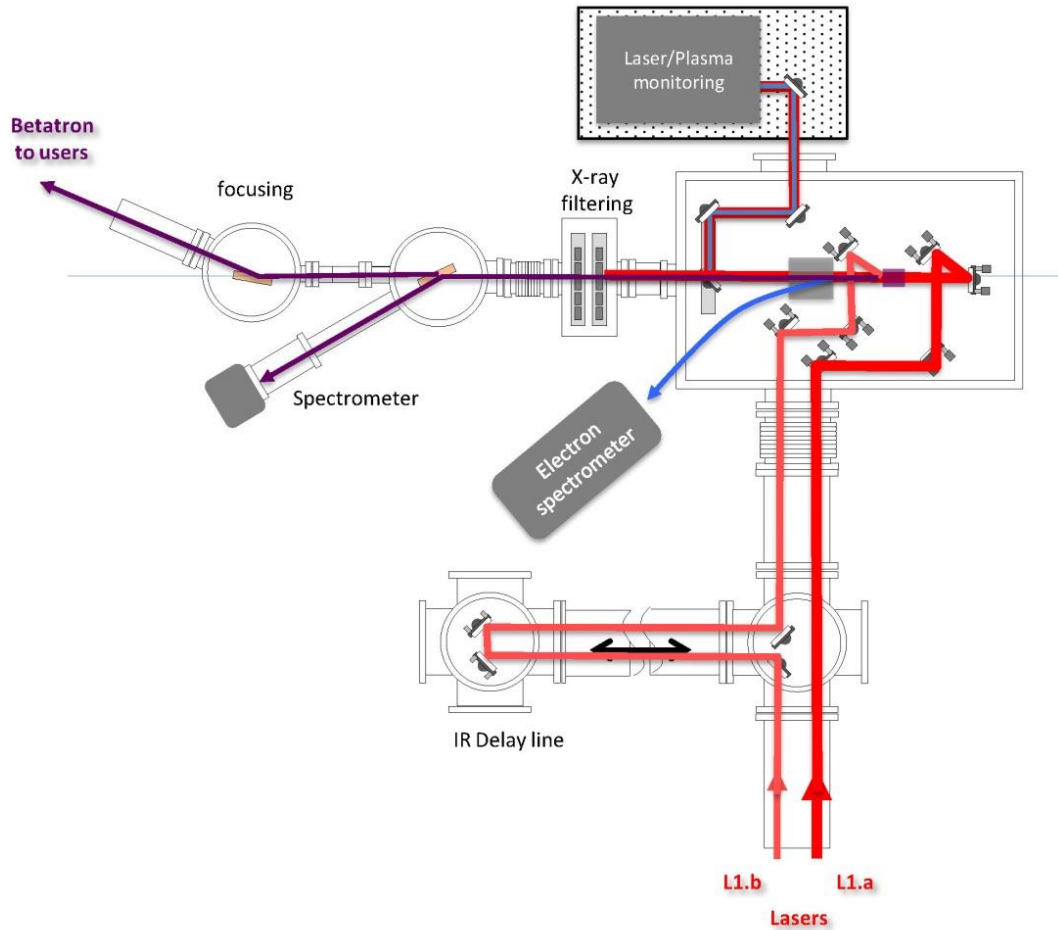
XUV and X-ray sources for E1 and E2: principles



High rep. rate laser-driven x-ray sources in E1 Betatron/Compton beamline in the E2 hall

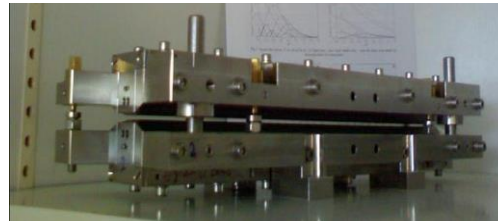
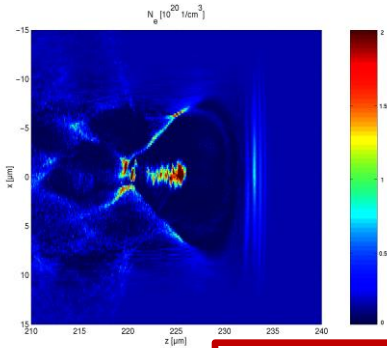


Design of kHz Betatron/Compton beamline

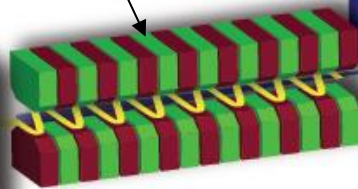


Laser undulator for generation of coherent X-rays (LUX) later X-FEL

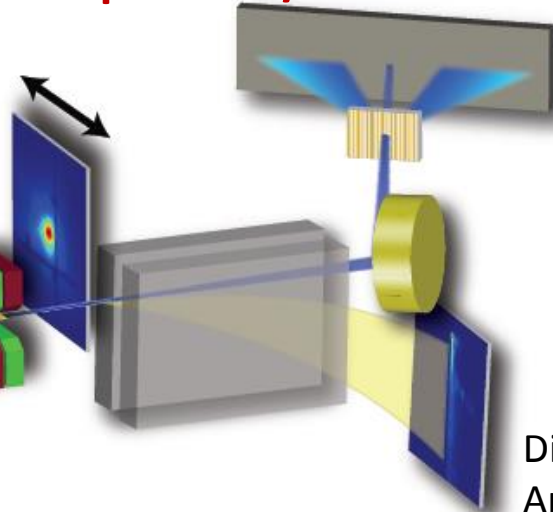
plasma stage



undulator
sub-cm period



Water window 10^6
photons/shot



Diagnostics
Applications

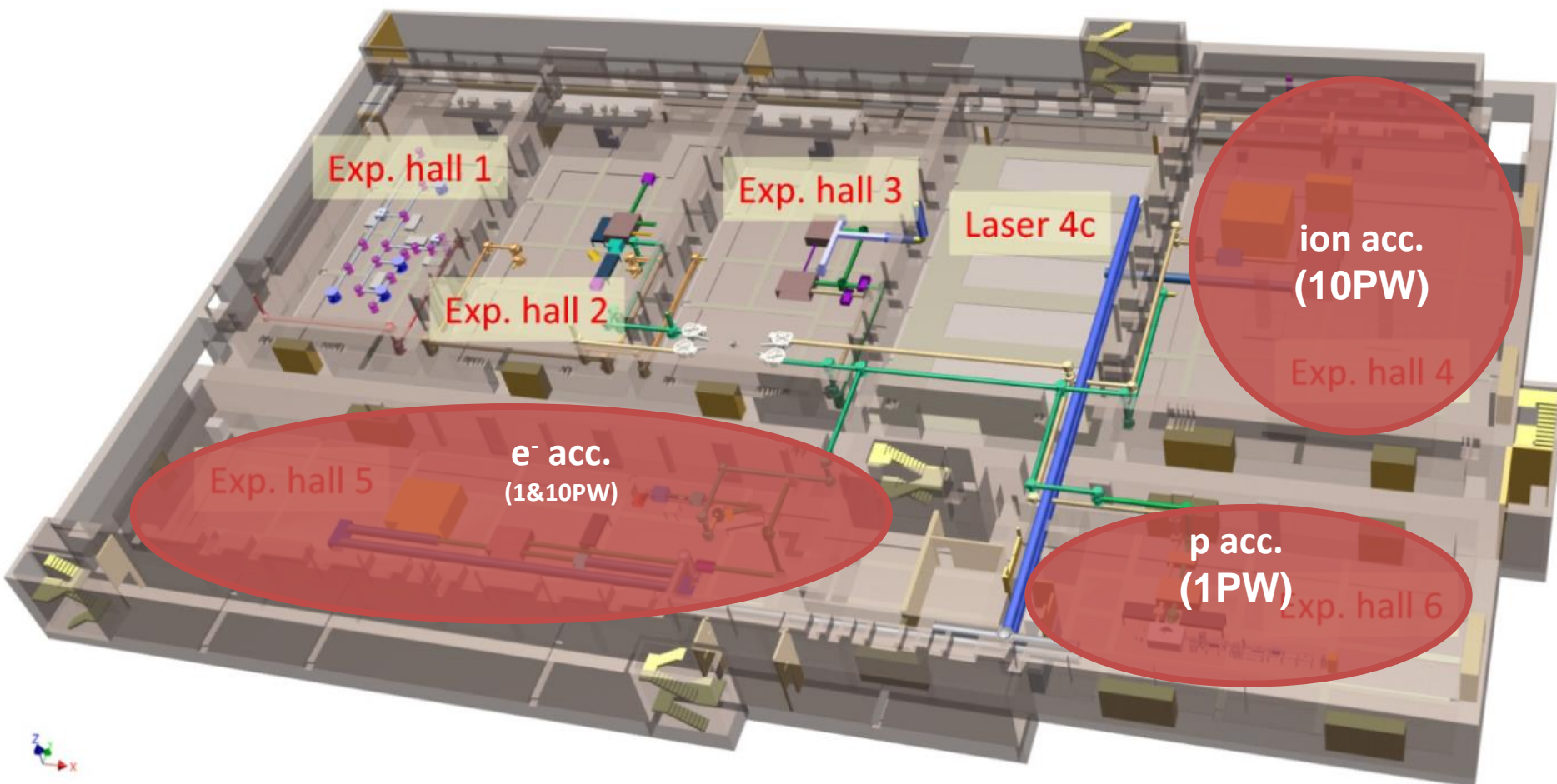
High-intensity laser
100 TW → few PW

magnetic lenses
500 T/m gradient



key challenges for FEL:
energy spread, charge, emittance
→ combine conventional and
plasma acceleration at DESY

Target Areas for RA3



Laser-Driven Proton Acceleration Enhancement by Nanostructured Foils

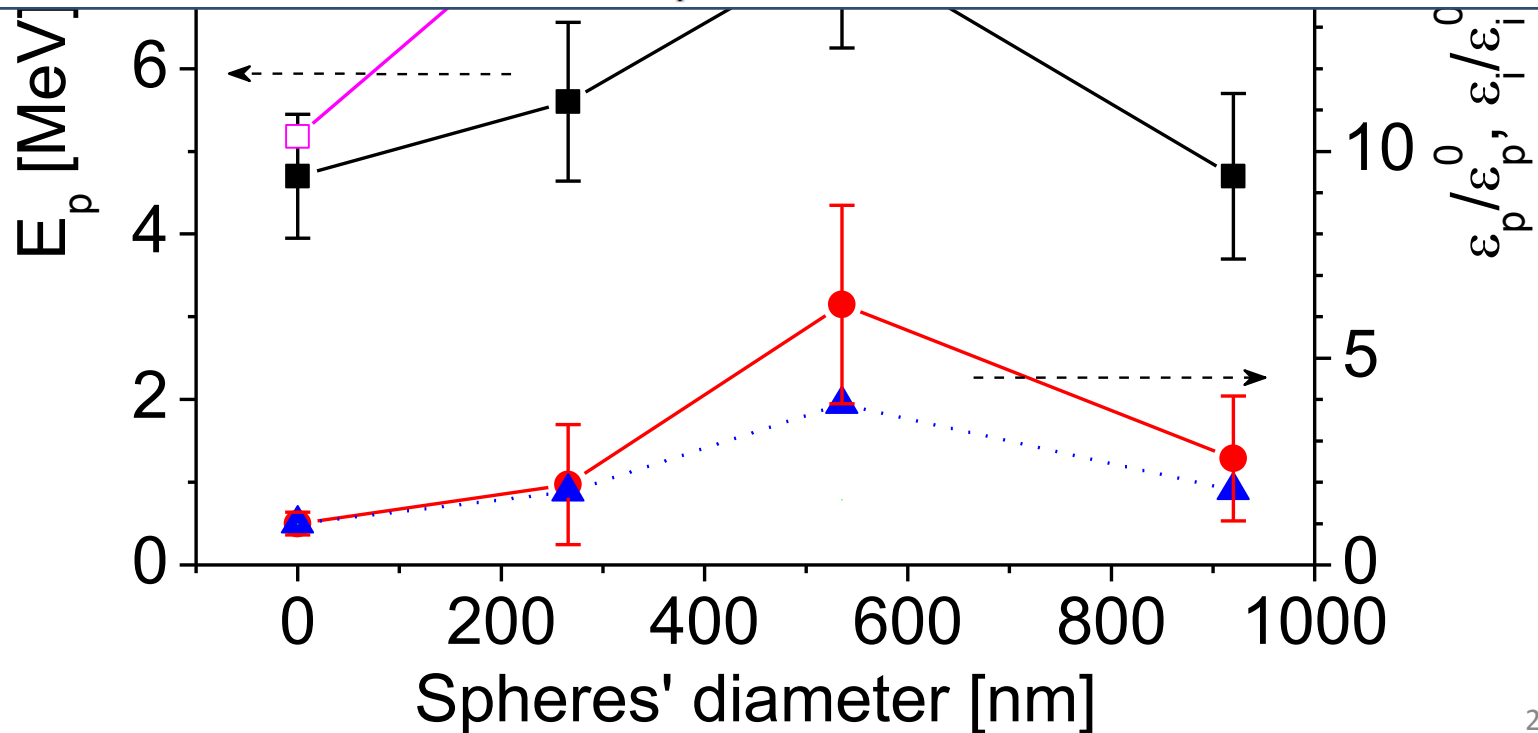
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High-Power γ -Ray Flash Generation in Ultraintense Laser-Plasma Interactions

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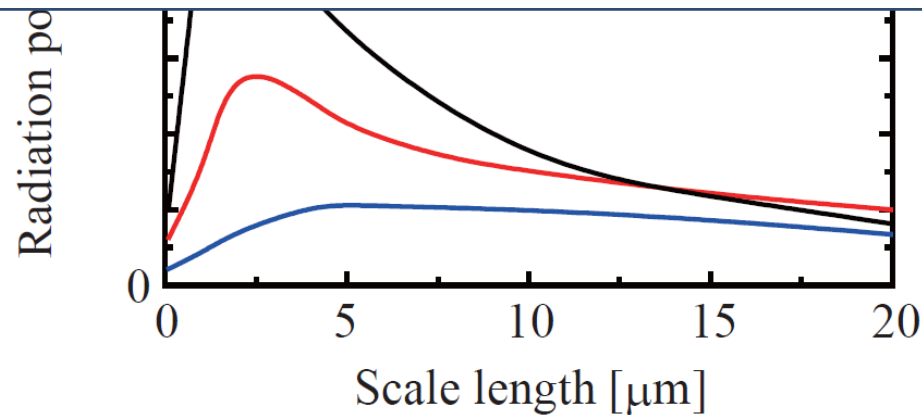
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Dependence of the gamma-ray power (PW) on the plasma scale length, L (μm) for the laser pulse energy of 300 J and the laser power, P , varying from 5 to 20 PW

Tatsufumi Nakamura^a, James K. Koga^a, Timur Zh. Esirkepov^a, Masaki Kando^a, Georg Korn^{b,c}, Sergei V. Bulanov^{a,d}, PRL April 2012



Thank you for your attention!
Please consider to come to
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