

EUROPEAN XFEL CONSTRUCTION STATUS

Winni Decking, DESY

for the European XFEL Project Team

Thanks to all colleagues for their contributions

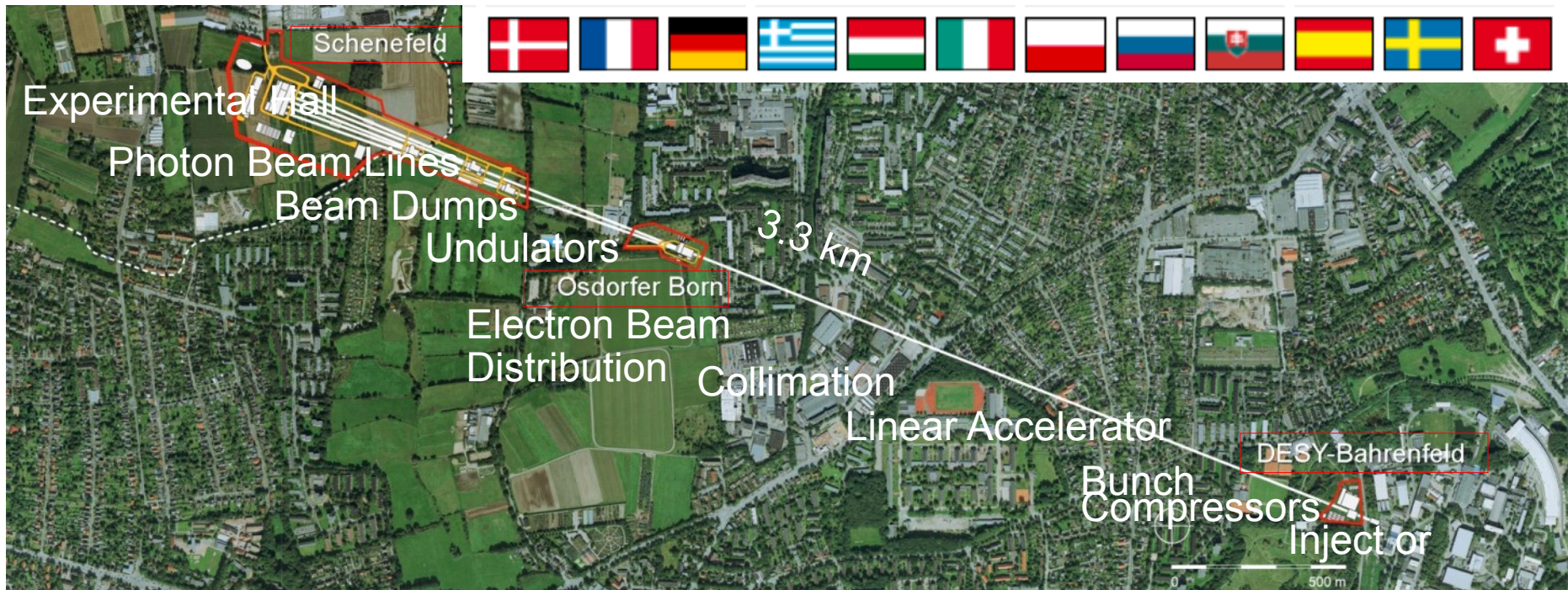
Visit the > 25 posters/talks related to European XFEL at this conference



HELMHOLTZ
ASSOCIATION

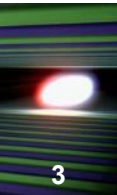
European XFEL at a Glance

- International project realised in Hamburg, Germany
- 17.5 GeV superconducting linac, almost 1 MW beam power
- 27000 pulses per second in 10 Hz burst mode
- Three variable gap undulators for hard and soft X-rays
- Initially 6 equipped experiments



Infrastructure & Injector

- On DESY campus
- Primary access to accelerator
- Linear accelerator infrastructure
- Injector

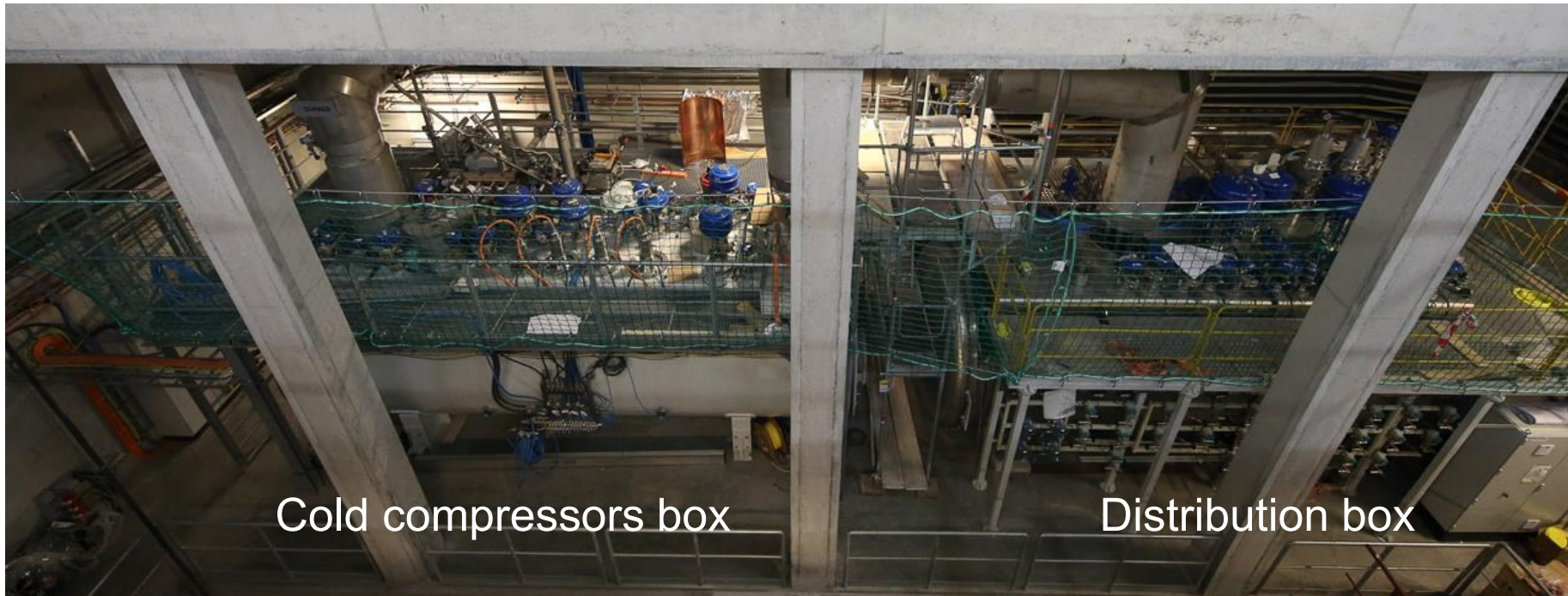


Cryogenic System - in operation

- Refurbished HERA cryo-plant (two lines)
- New distribution boxes and transfer lines
- 4 cold compressors in one cryo-box in entrance shaft

Specifications

2K	1869 W
5/8K	3593 W
40/80K	23923 W



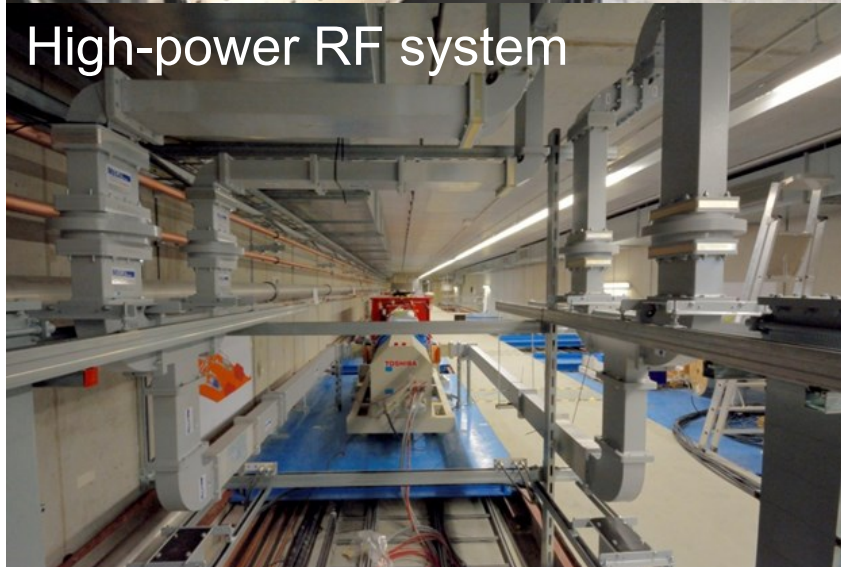
Laser



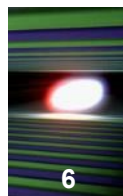
Photo Injector



High-power RF system



10.02.2015:
First photoelectrons at XFEL
About 3 nC, 20 bunches, 10 Hz

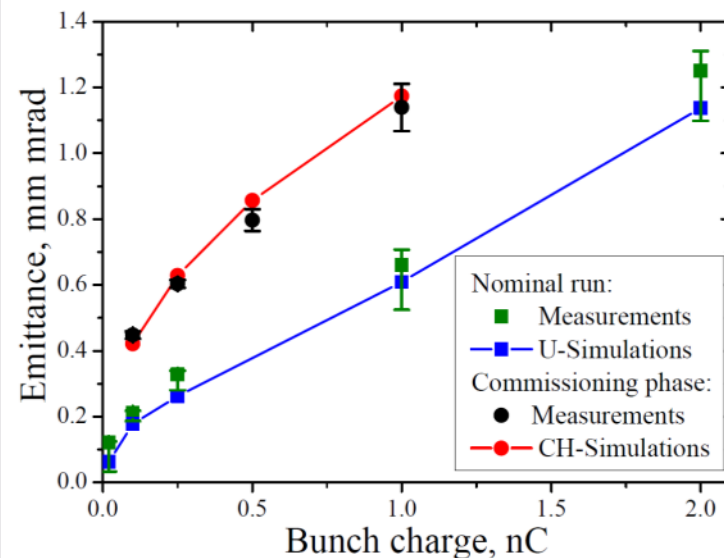


Gain material	Yb:YAG
Intra burst rate	4.5/n MHz, $n \geq 1$
Pulse properties	Short pulse: < 3 ps (FWHM), > 0.7 μ J per pulse Long pulse: \sim 10 ps (FWHM), > 3 μ J per pulse Shaped 20 ps with 2 ps rising edges (Phase 2)

System	Modulator in separate building Long HV pulse cable Pulse Transformer Multi beam klystron
Parameters	1.3 GHz, 10 Hz, 1.3 ms., 10 MW
Waveguide	Four 50 m long air-filled, 1.5 MW each

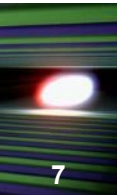
Type	1.3 GHz, 1.6 cell nc cavity
Cathode	CsTe
Peak Power	6.5 MW (5.5 MW during fist operation) 0.02 C– 1 nC
Average Power	60 kW
Charge	0.02 nC – 1 nC

Proj.
emittance
(PITZ)

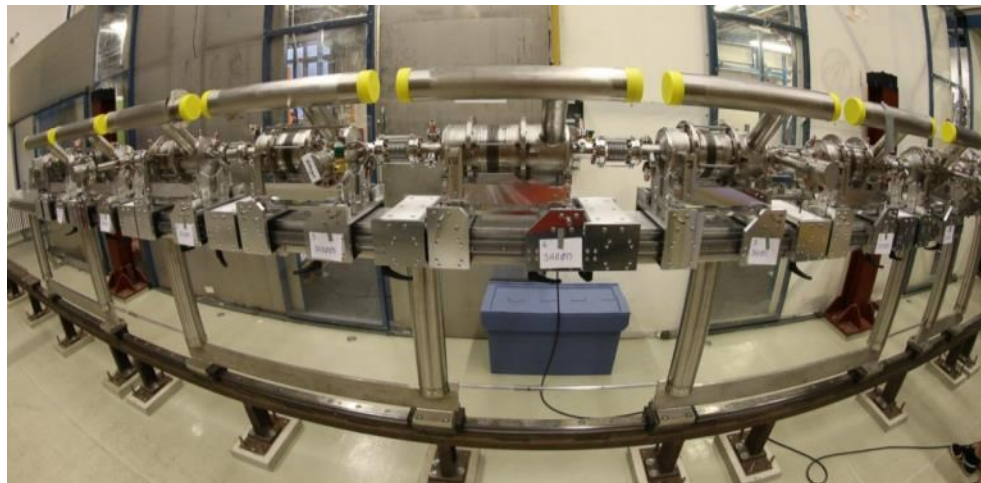


See G. Vashchenko, MOD04

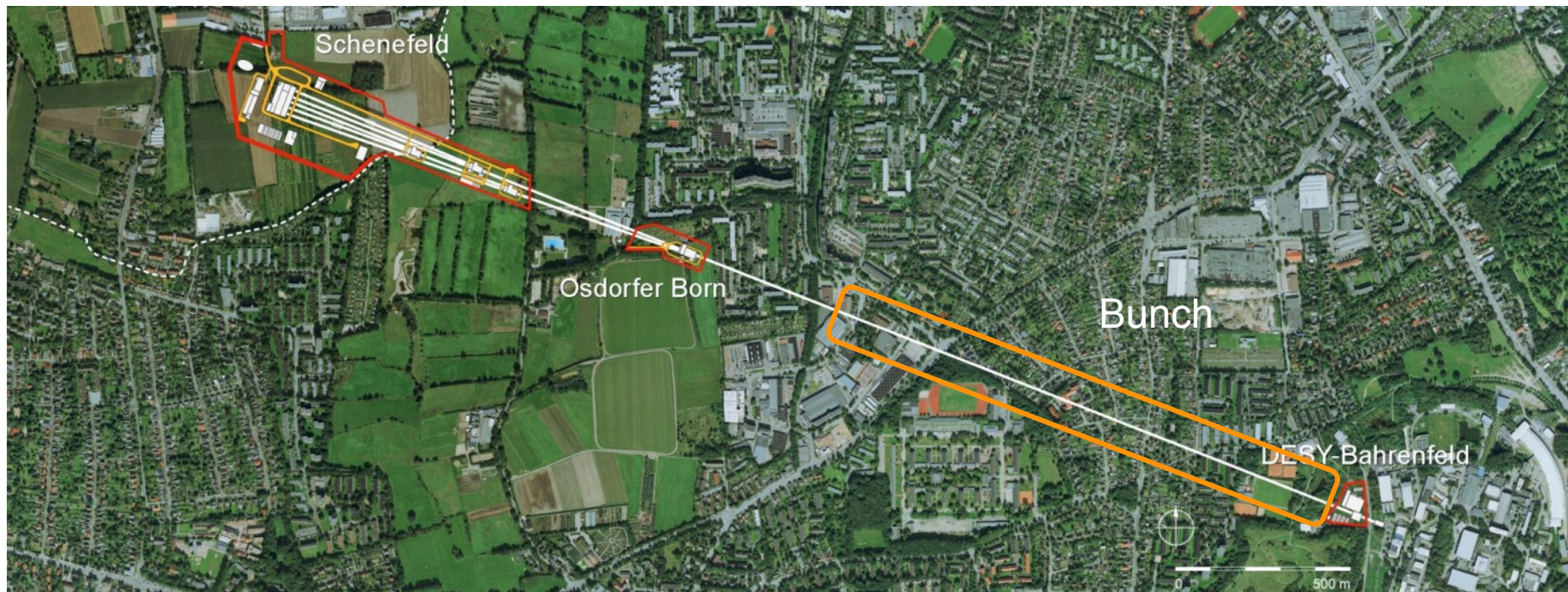
European XFEL Injector



- Installed up to 150 MeV commissioning dump
- Laser heater and diagnostic section (see M. Hamberg, TUP038 ; M. Scholz, TUP068; H. Huck, MOP039; H. Dinter, TUP049)
- Schedule driven by completion of 3.9 GHz system
- Start of injector operation planned for 11/2015

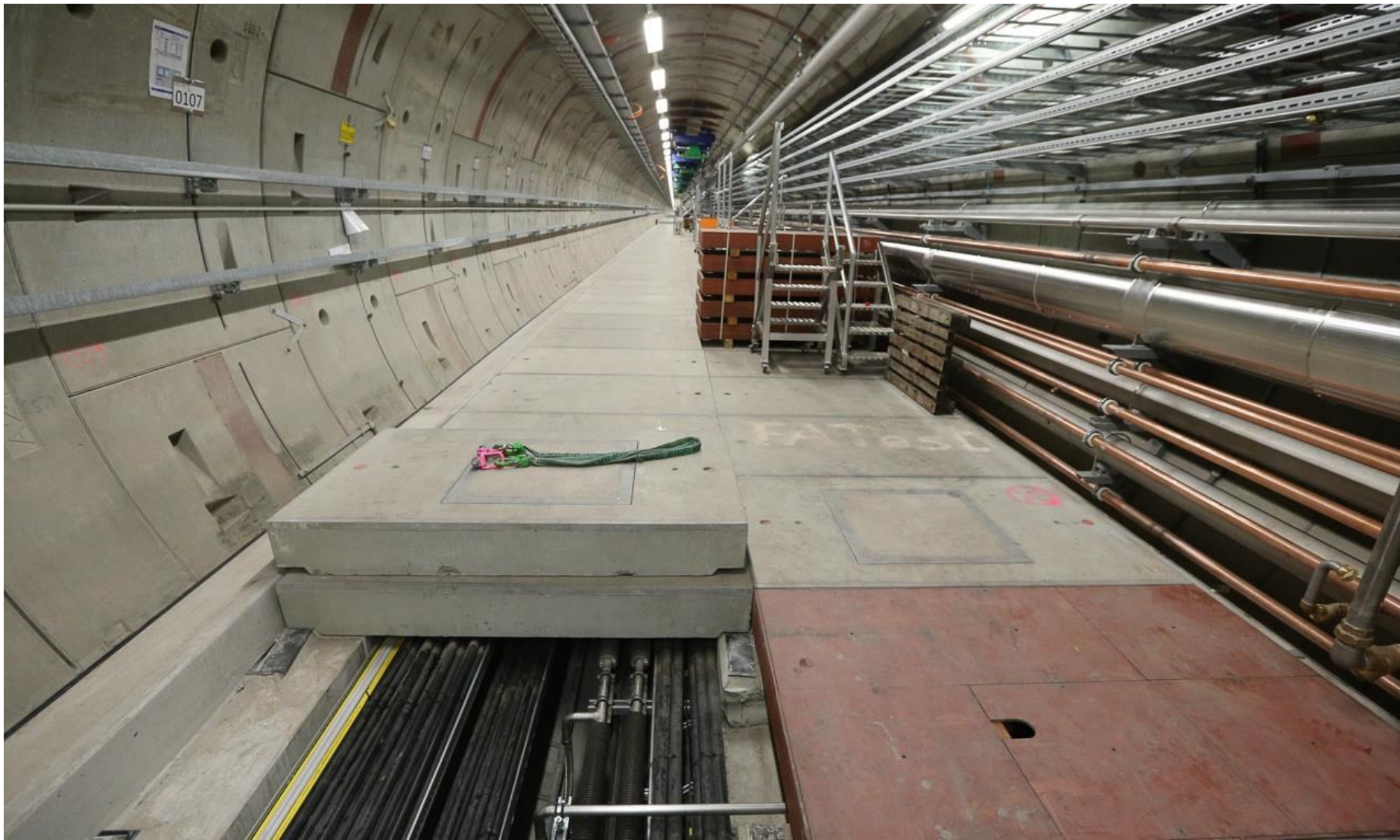
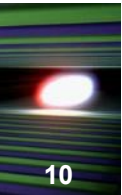


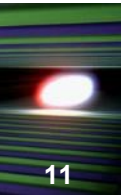
- 100 accelerator modules with eight 9-cell cavities each
- Design gradient 23.6 MV/m
- 25 RF stations – each supplying 4 modules



Linear Accelerator – Tunnel View February 2012





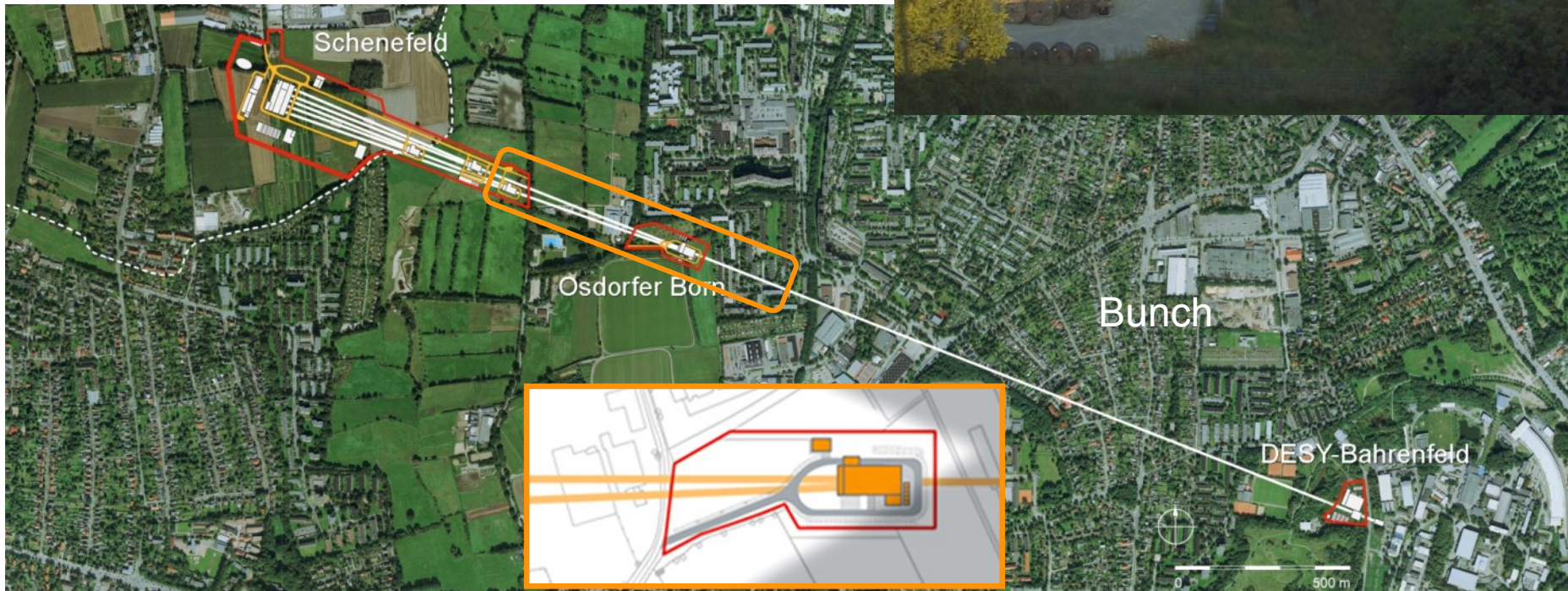


- Cavities:
 - > 80% of 808 cavities tested
- Modules:
 - \approx 2/3 of 101 modules assembled
 - 50% tested (average gradient 27.1 MV/m)
 - 1/3 installed
- RF Stations:
 - 3 of 27 stations installed
- Fabrication/assembly/testing rate meets project goal, sufficient installation rate to be established

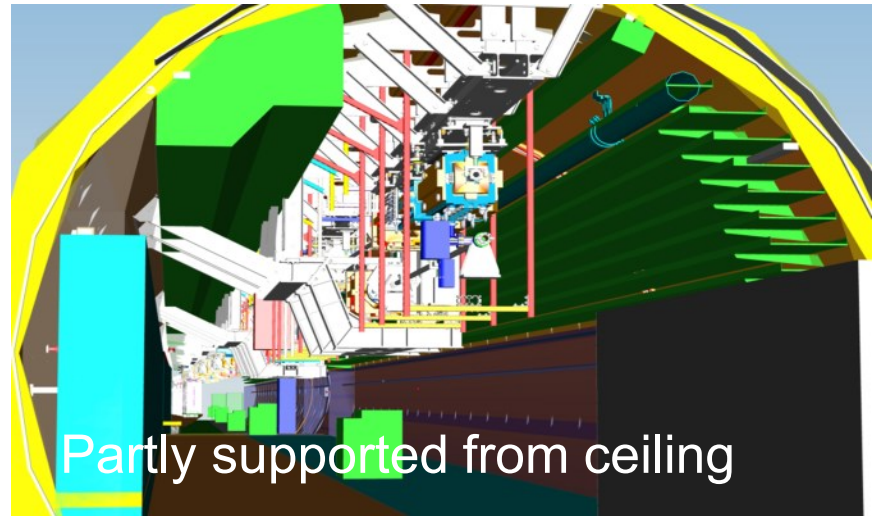
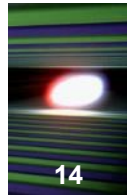


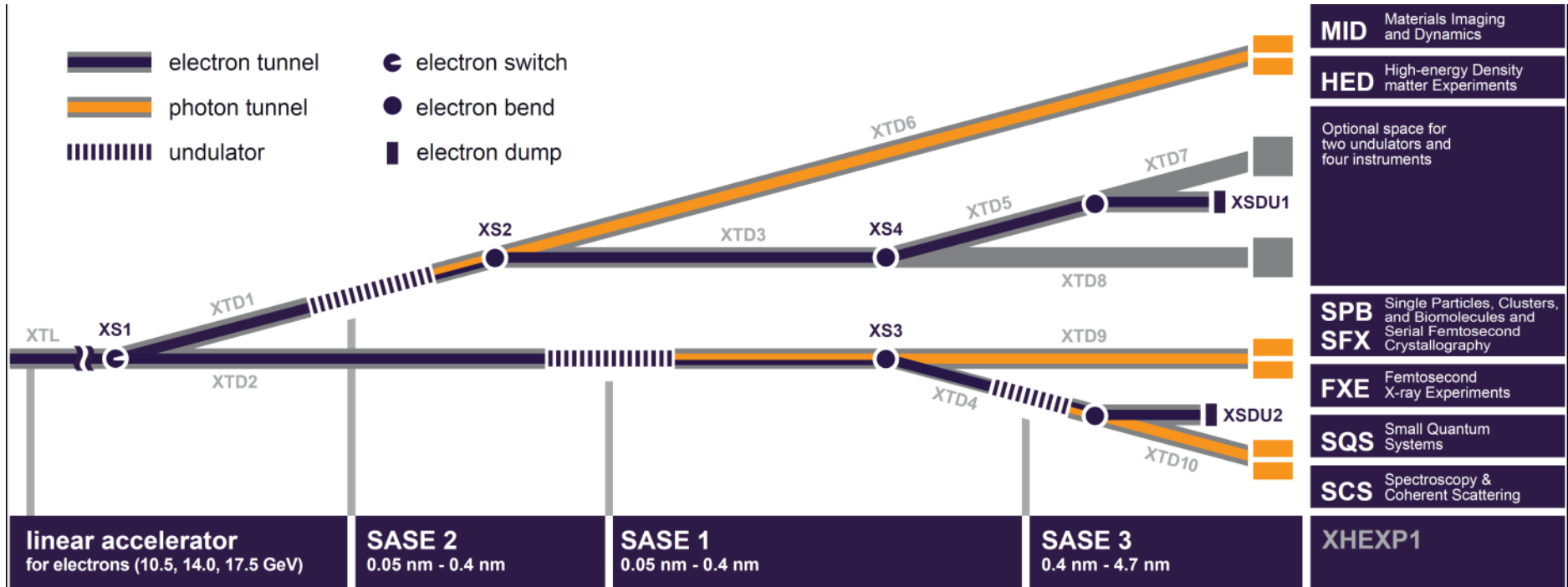
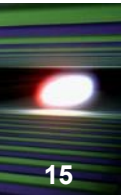
Electron beam distribution

- First access to tunnel after 2 km
- Beam collimation and distribution into 3 beamlines (2 x SASE & dump)



Electron beam distribution

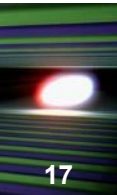




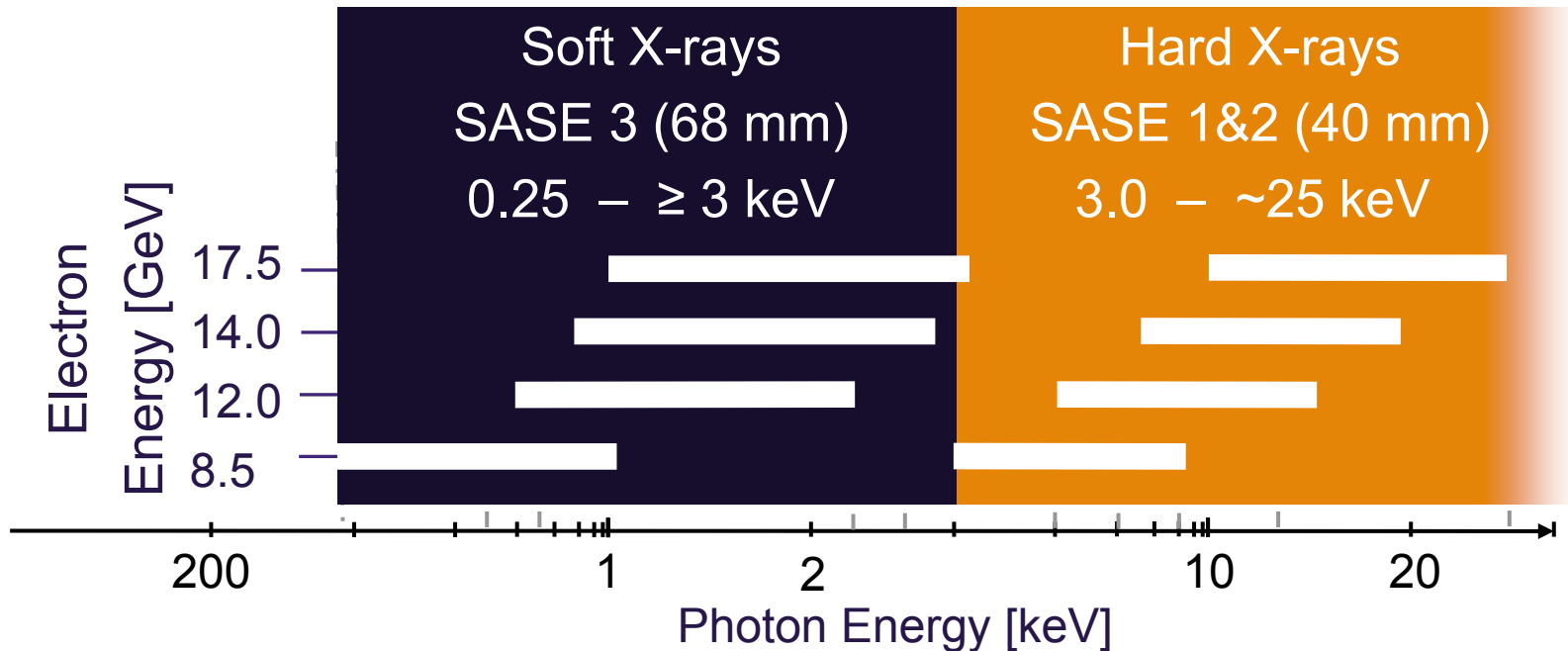
All 91 segments tuned

Quantity	SASE1/SASE2	SASE3
System length	213.5 m	128.1 m
Number of segments	35	21
λ_0	40 mm	68 mm
K-Range	3.9 - 1.65	9.0 - 4.0
Operational Gap Range	10 - 20 mm	10 - 25 mm





First undulator installed in the tunnel



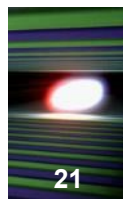
- Self-seeding implementation at SASE2 (see G. Geloni, WEP028)
- Construction of two chicanes to be installed after SASE commissioning
- More SASE options exploited (see M. Yurkov, MOC02; V. Kochatryan, MOP085; E. Saldin, MOP086)

- Up to 900 m long photon beamlines
- Challenges:
 - XFEL time structure
 - Peak power density (up to 20 GW/mm^2 for 150 fs)



- Component installation started
- Mirrors (9) for photon beam transport in production (specifications: ≈ 1 m substrate length, shape error < 2 nm, roughness 1 \AA)





Dedicated **photon diagnostics** for (non)invasive measurement of intensity, position and spectrum

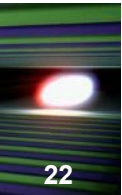
(see J. Grünert, WED03; J. Viefhaus, WED02)



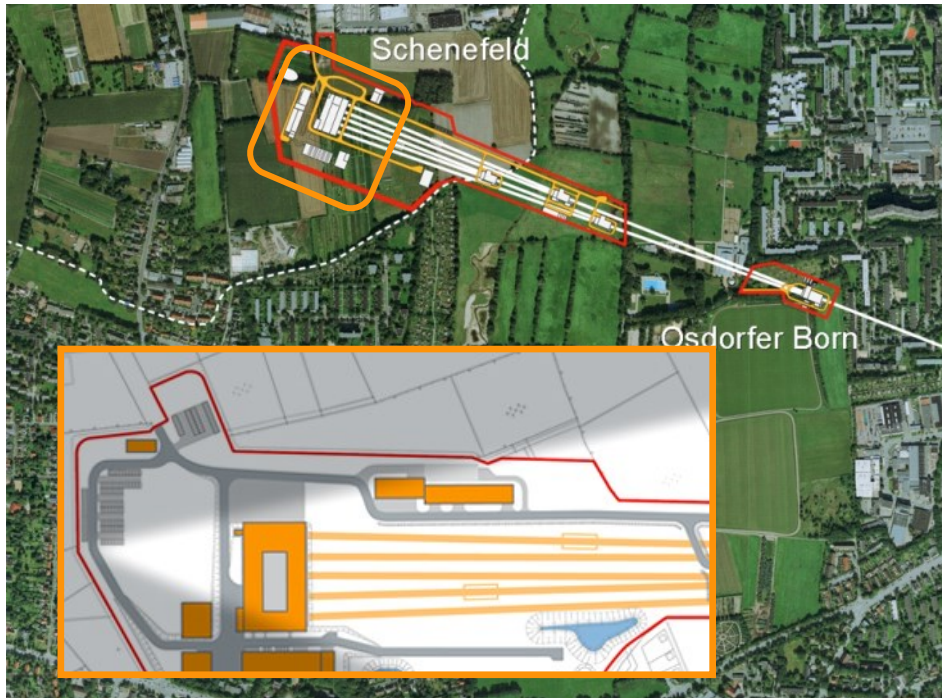
Pop-in imager installed in tunnel



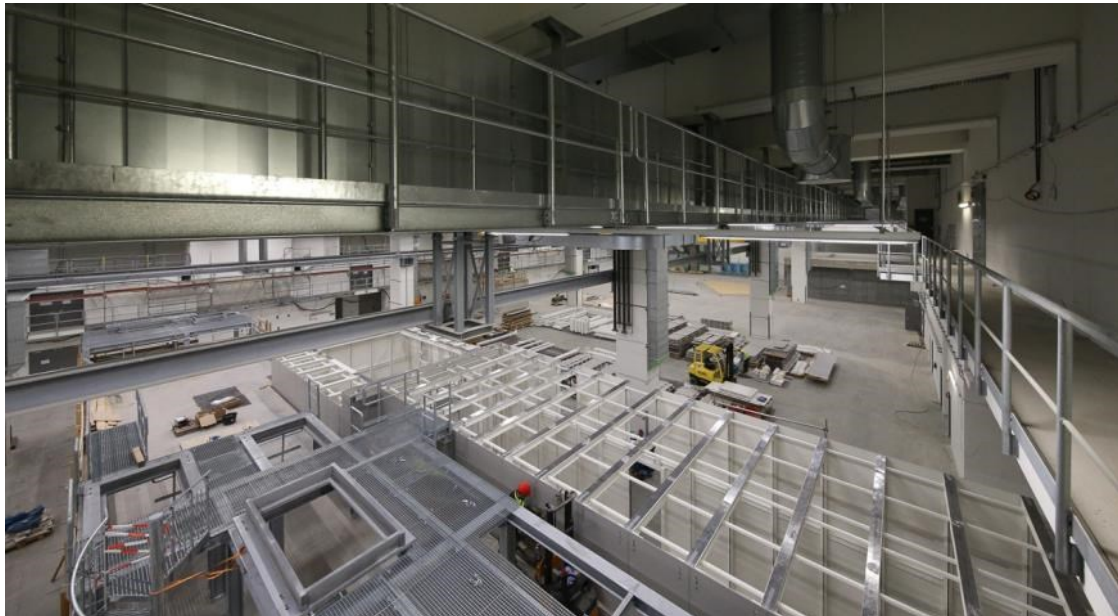
X-Ray gas monitor ready for installation



- New campus with experimental hall, laboratory and office building, infrastructure buildings



- Hutch construction started
- Experiments component development and construction
- First large components already installed during hutch construction



MID Materials Imaging and Dynamics

HED High-energy Density matter Experiments

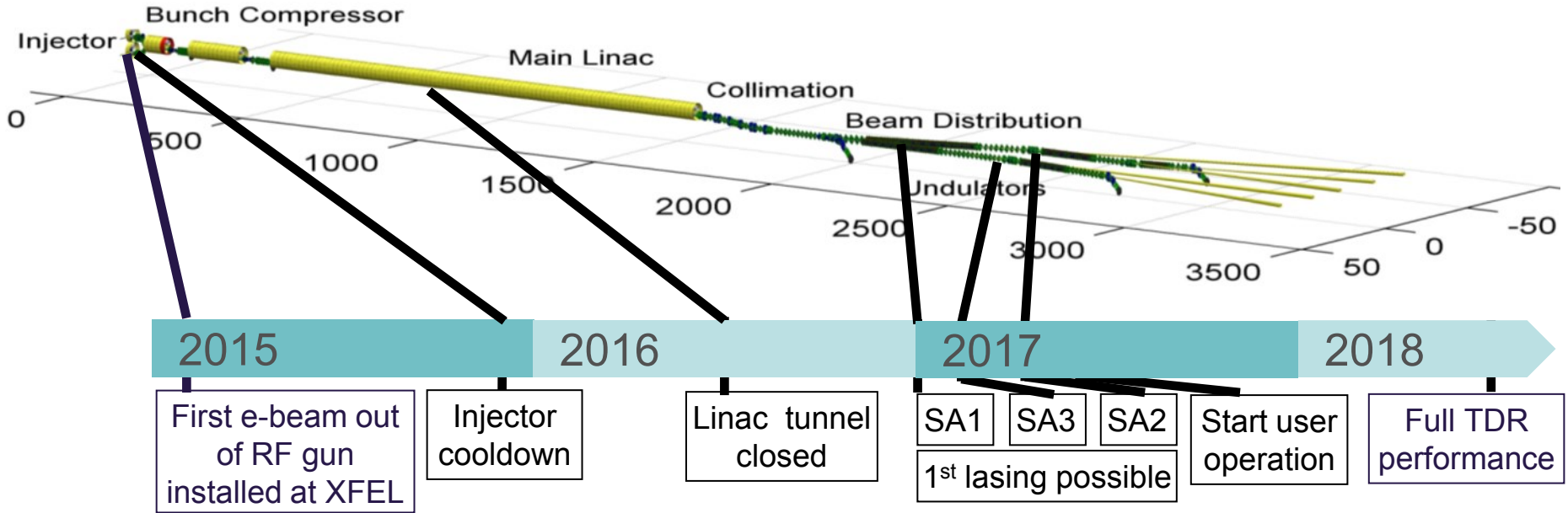
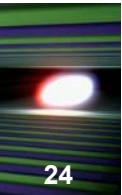
SPB Single Particles, Clusters, and Biomolecules and
SFX Serial Femtosecond Crystallography

FXE Femtosecond X-ray Experiments

SQS Small Quantum Systems

SCS Spectroscopy & Coherent Scattering

Timing distribution for 3 km facility see: C. Sydlo, WEO047; E. Janas, TUP045; M. Felber, MOP040; M. Xin, MOP042; B. Windisch Green, WEP046



e ⁻	Gun and injector laser com.	Injector com. up to full XFEL performance (varying charges and bunch patterns)	Initial linac com. with reduced performance	Continued accelerator com. to full performance (high beam power, bunch length flexibility, multiple bunch properties per rf-pulse, full wavelength tuneability,)
	γ			Beam line and experiment com.
				First user operation

Good progress towards our goal to close
accelerator tunnel by mid of 2016 and enable the
possibility of first SASE light through this hole by
end of 2016

