

EUROPEAN XFEL CONSTRUCTION STATUS

Winni Decking, DESY

Frederic Le Pimpec, European XFEL GmbH
for the European XFEL Project Team

Thanks to all colleagues for their input

Most pictures courtesy Dirk Nölle

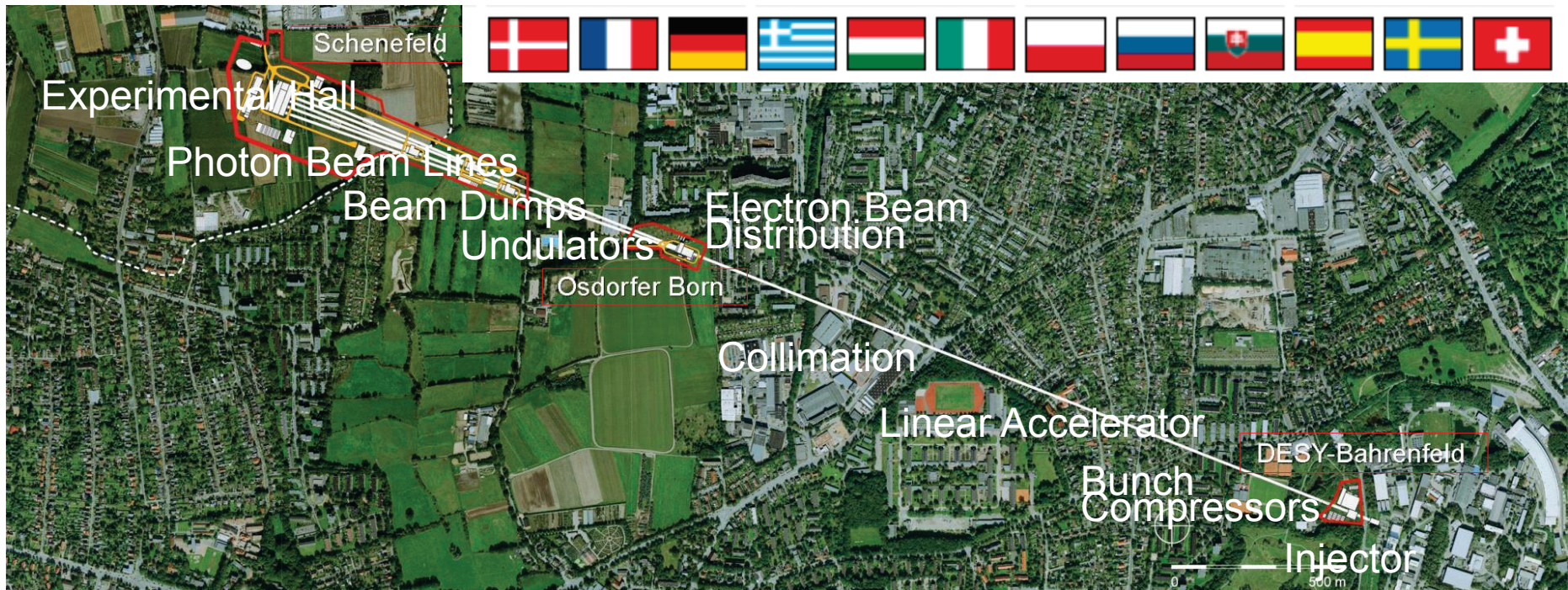
Visit the > 30 posters/talks related to European XFEL at this conference

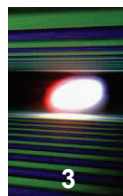


HELMHOLTZ
ASSOCIATION

European XFEL at a Glance

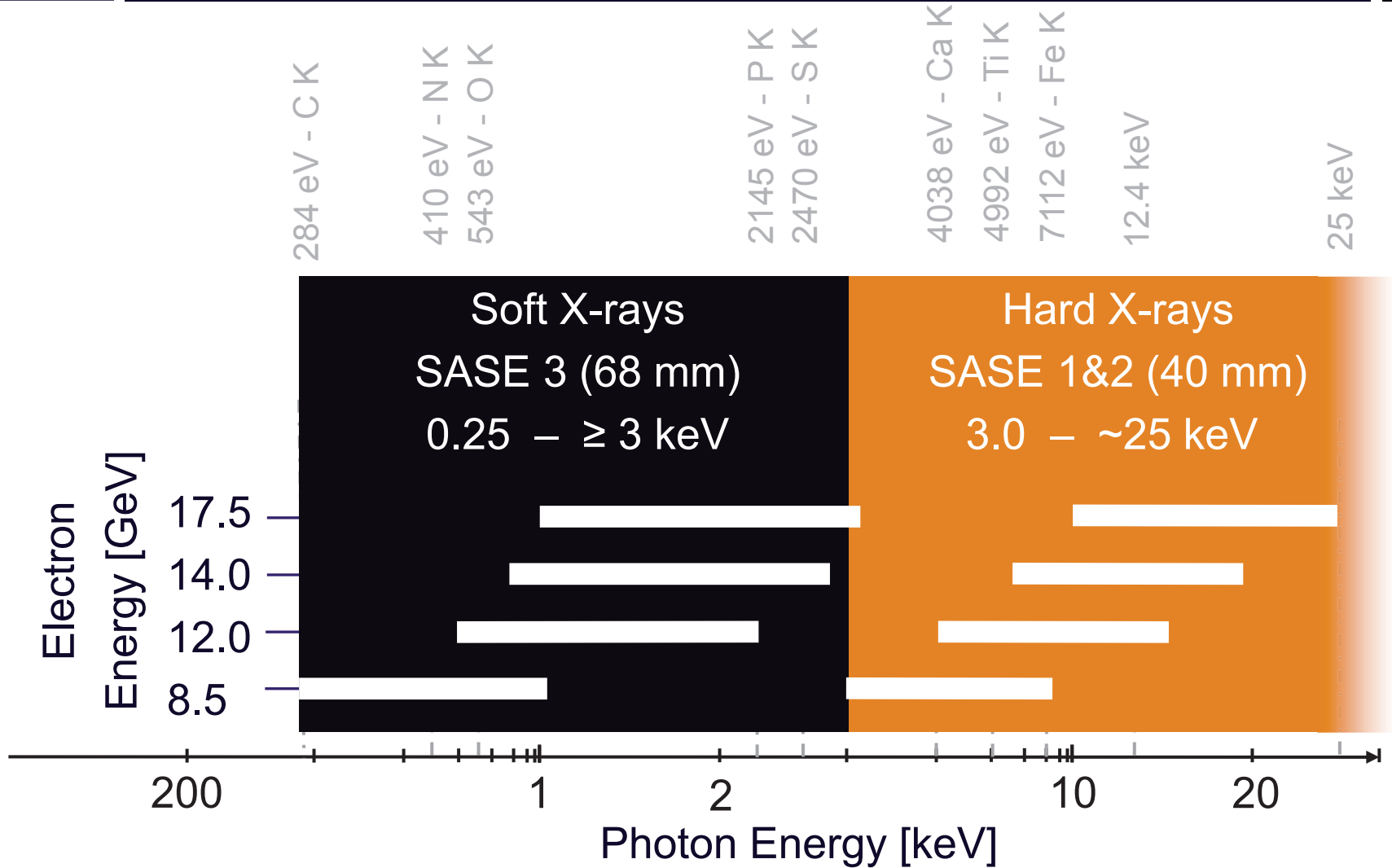
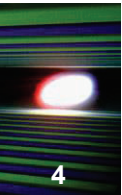
- Up to 17.5 GeV superconducting linac
- 27000 pulses per second in 10 Hz burst mode
- Three moveable gap undulators for hard and soft X-rays
- Initially 6 equipped experiments
- Built by 12 European Nations in Northern Germany



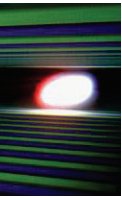


Quantity	Value
max. electron energy	17.5 GeV
beam power	500 kW
pulse repetition rate	10 Hz
beam pulse length	600 μ s
bunch repetition frequency within pulse	4.5 MHz
electron bunch length after compression	2 – 180 fs (FWHM)
bunch charge	0.02 – 1 nC
slice emittance	0.4 - 1.0 mm mrad
slice energy spread	4 – 2 MeV

Covers photon energies from 0.25 keV to 25 keV



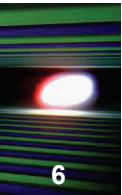
Underground construction finished



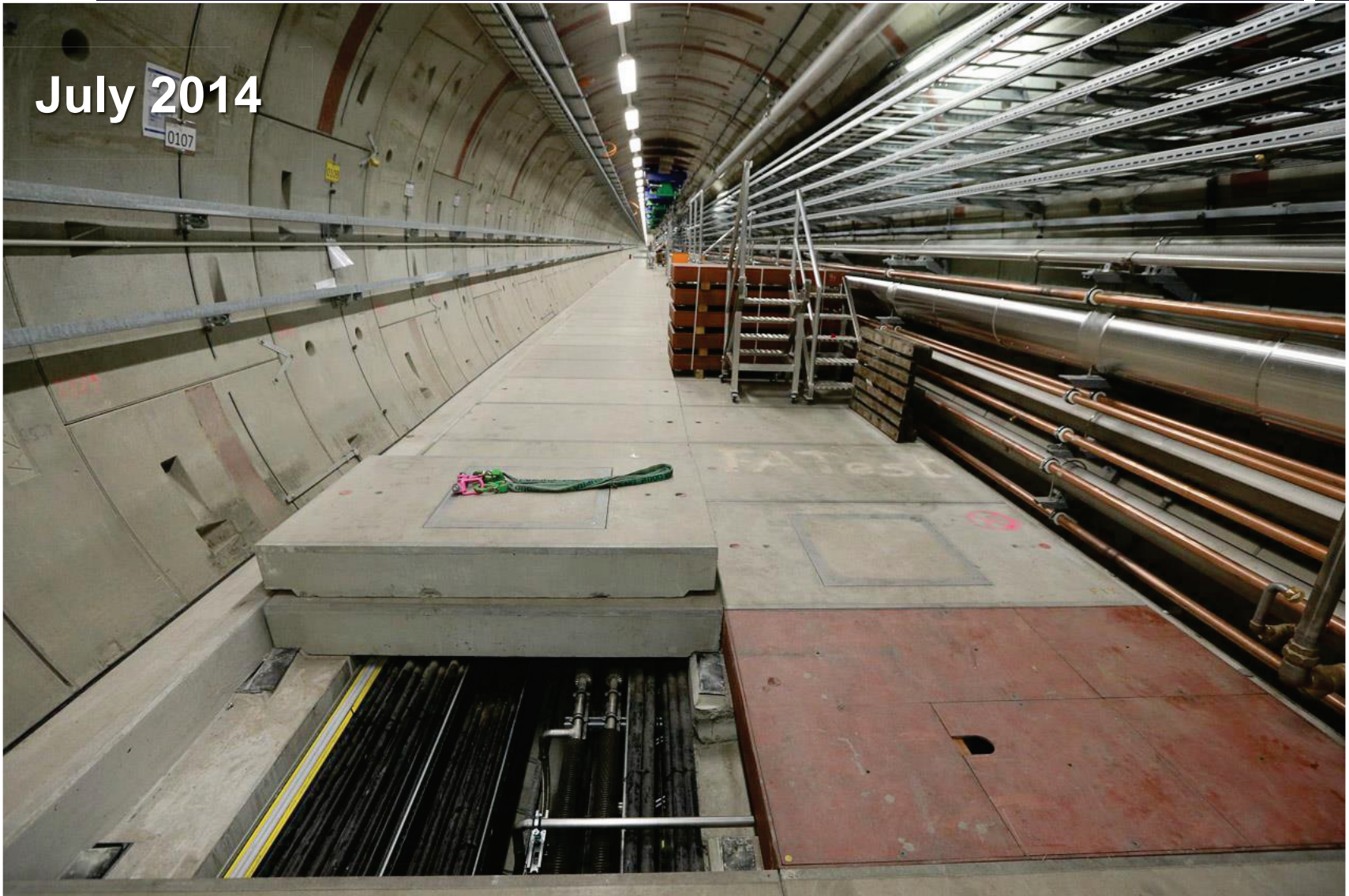
February 2012



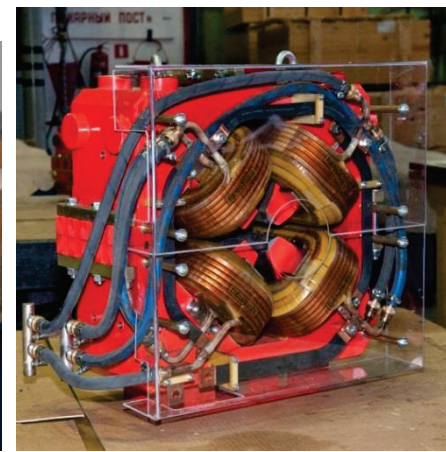
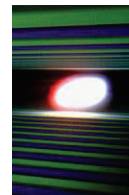
... and technical infrastructure installed

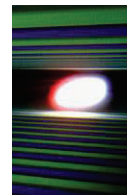


July 2014

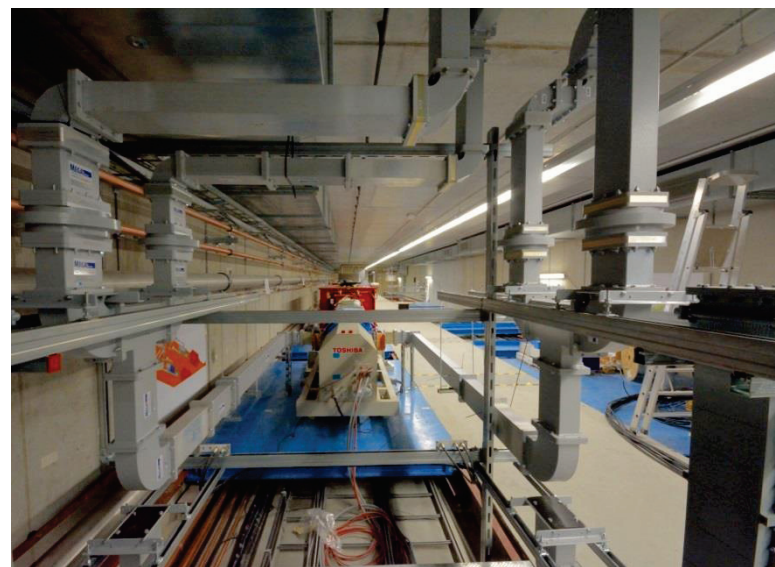


Many accelerator components produced





Gun conditioned at PITZ/DESY
RF operation at XFEL December 2013



Cavity and Module Production



- > 50% of cavities delivered to DESY by RI and Zanon
- Most accepted after first test, some retreated
- Average useable gradient almost 30 MV/m (23.6 MV/m required)

Cavity and Module Production

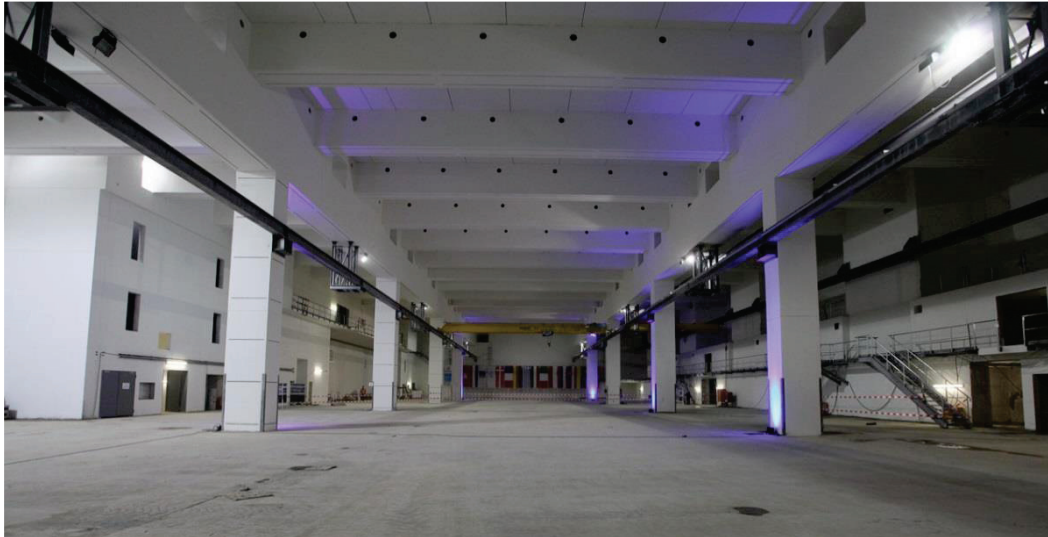
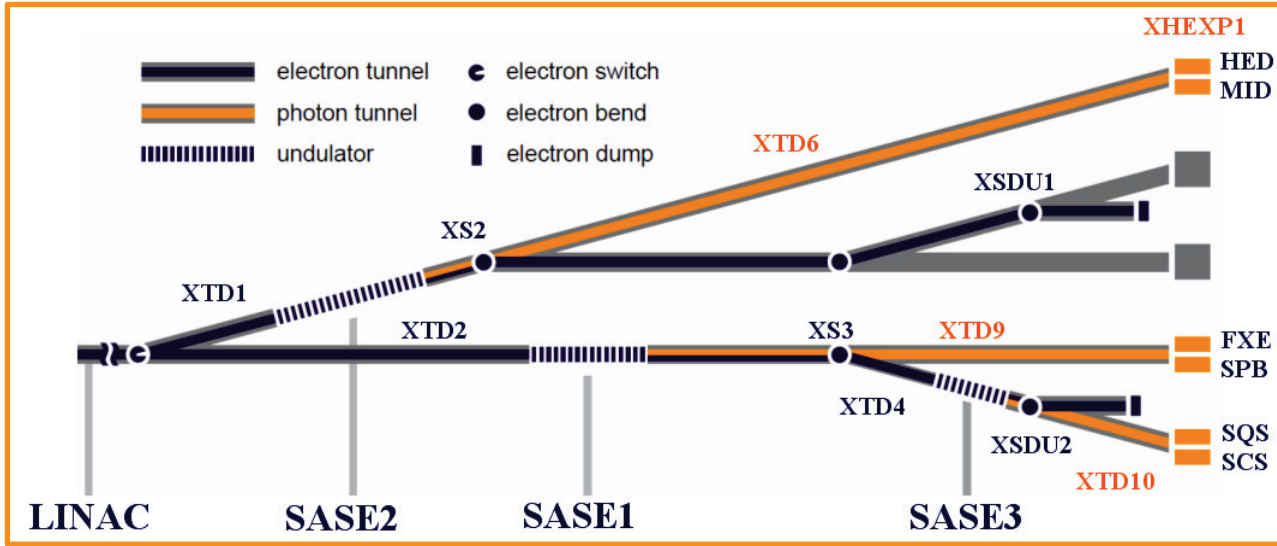
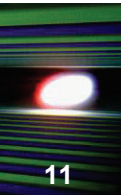


- > 50% of cavities delivered to DESY by RI and Zanon
- Most accepted after first test, some retreated
- Average useable gradient almost 30 MV/m (23.6 MV/m required)

- So far 9 series modules assembled by CEA Saclay
- Tested modules fulfill/exceed XFEL specs
- Increased assembly rate necessary to fit project schedule



Photon systems

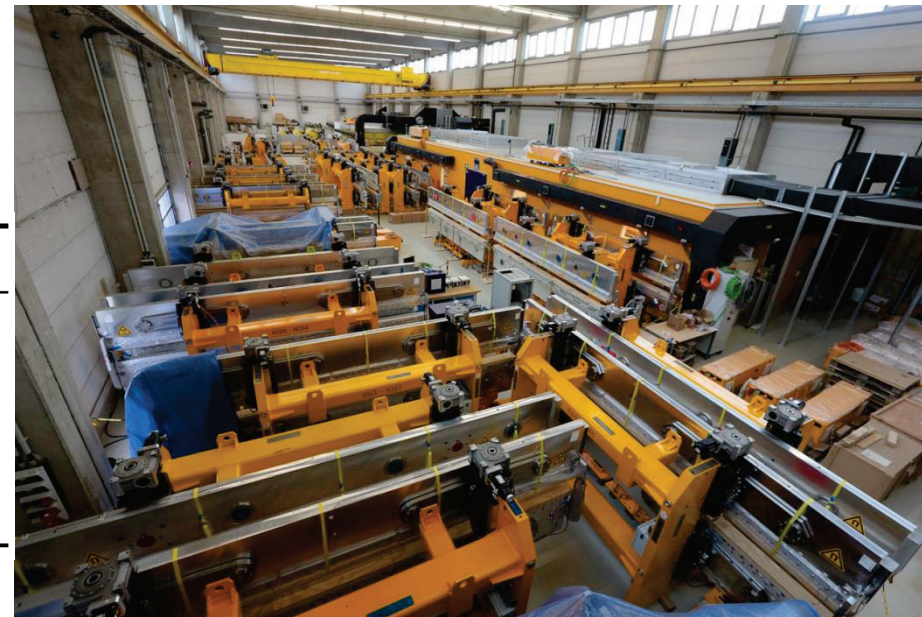


Undulator Production and Tuning



- Total 91 segments
- > 80% measured and tuned
- Installation start early 2015

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



Challenges for photon delivery

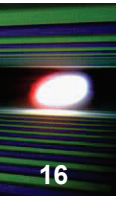
- *XFEL time structure*
- *Peak power density (up to 20 GW/mm² for 150 fs)*

Challenges for photon delivery

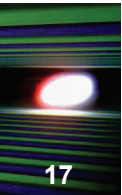
- *XFEL time structure*
- *Peak power density (up to 20 GW/mm² for 150 fs)*
- Development of dedicated **photon diagnostics** for noninvasive measurement of intensity, position and spectrum

Challenges for photon delivery

- *XFEL time structure*
- *Peak power density (up to 20 GW/mm² for 150 fs)*
- Development of dedicated **photon diagnostics** for noninvasive measurement of intensity, position and spectrum
- **Photon beam transport** has first mirrors several 100 m from source, extreme specs:
 - Almost 1 m substrate length
 - Mirror shape error < 2 nm (peak to valley)
 - Roughness 1 Å RMS
 - 6 flat, 3 bendable mirrors needed, coated with B₄C (and Pt)

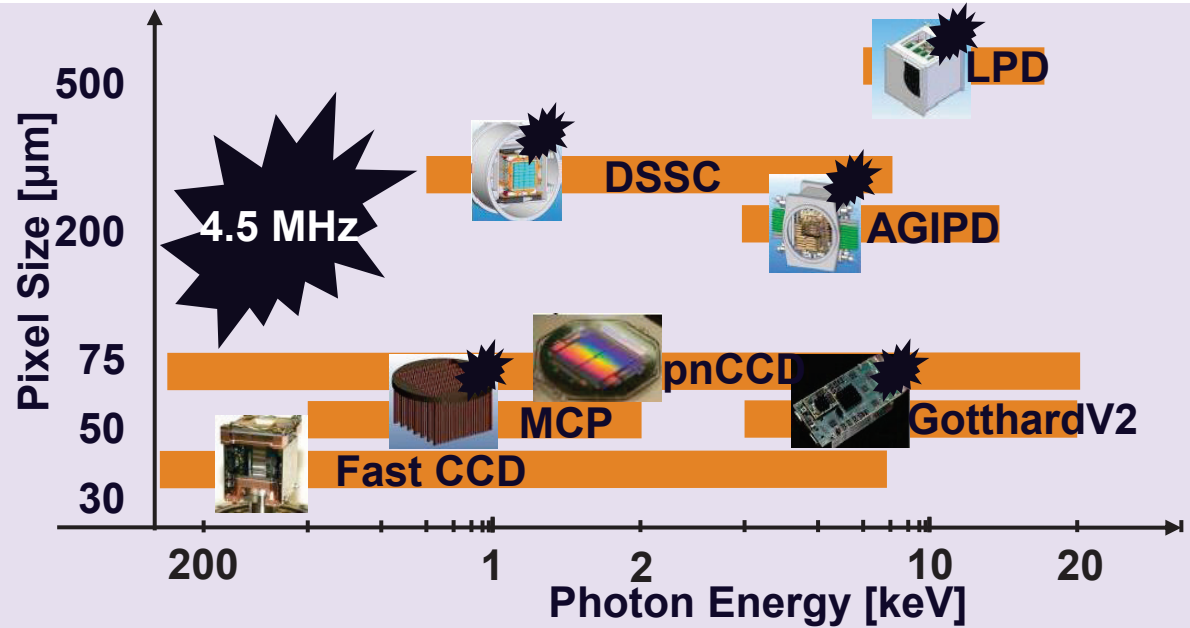


Have to fit to time structure



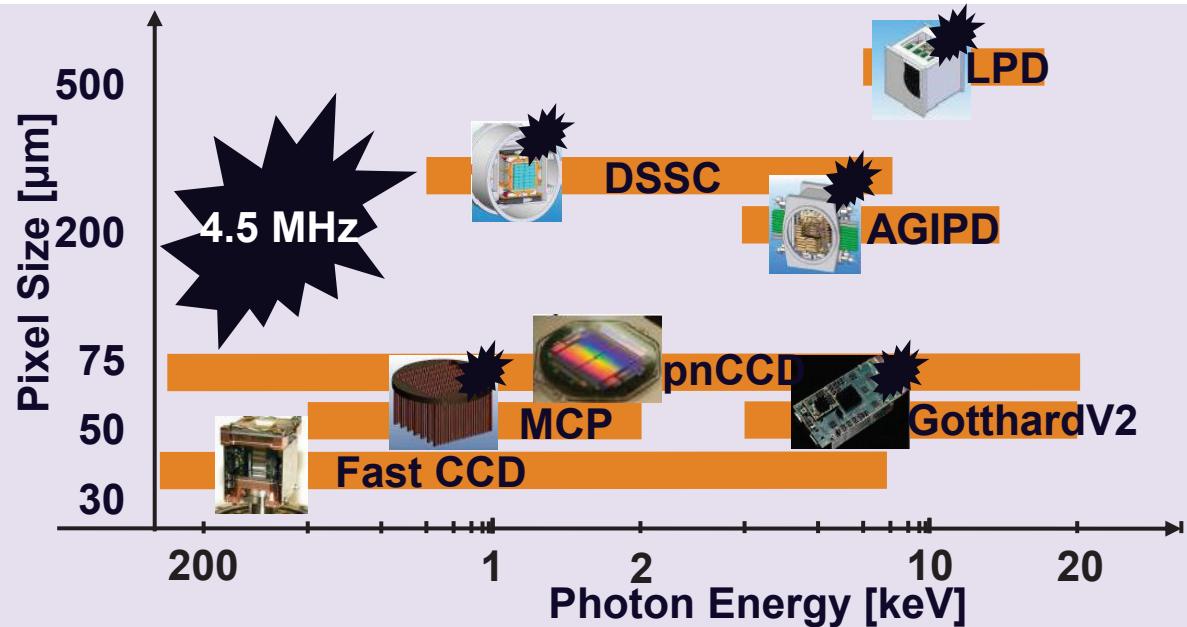
Have to fit to time structure

■ **Detector development**



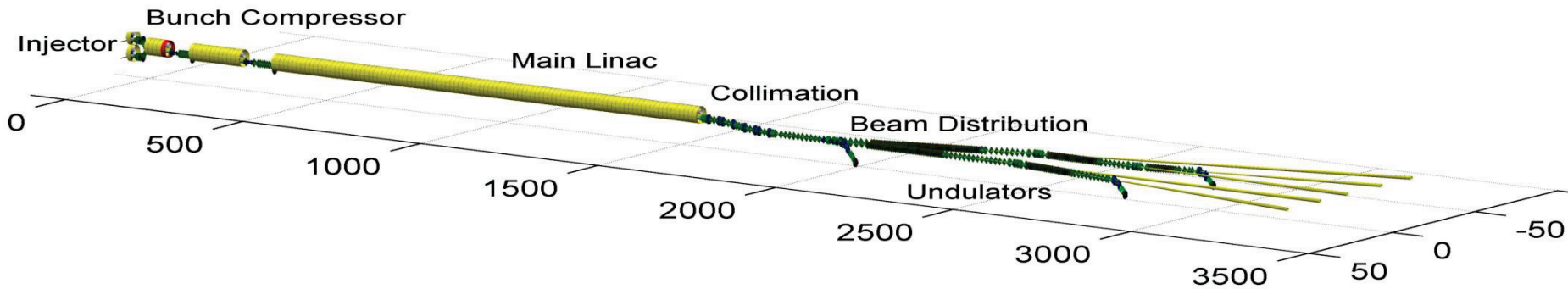
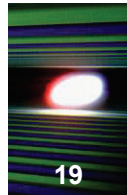
Have to fit to time structure

Detector development

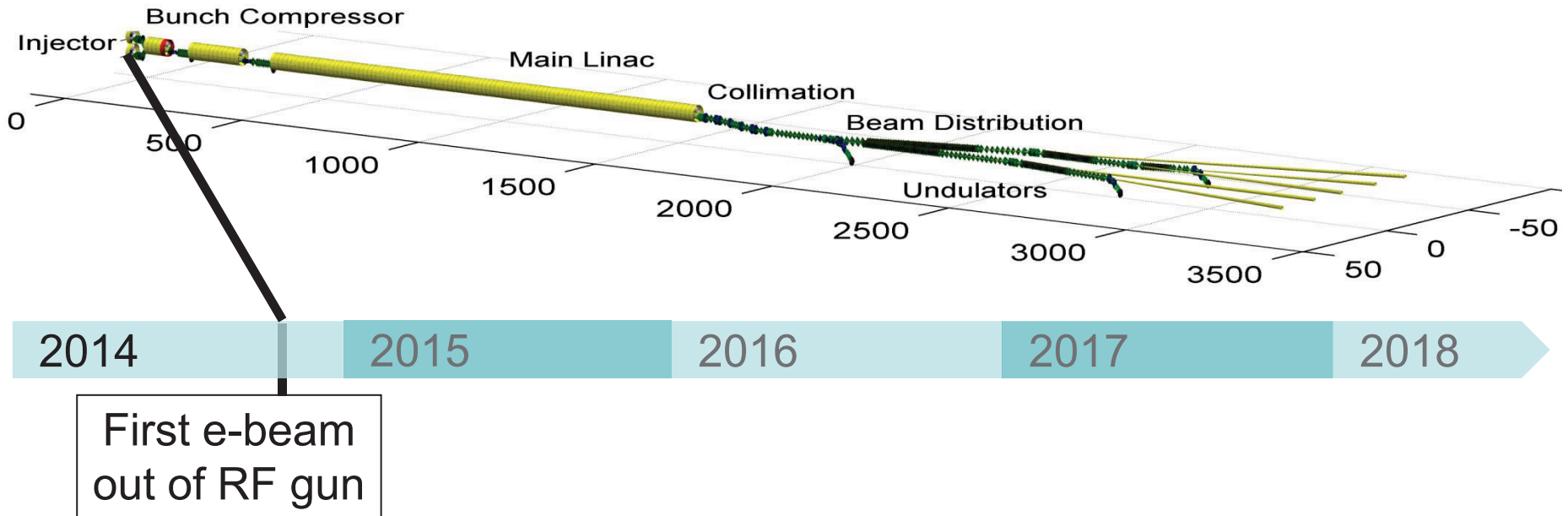
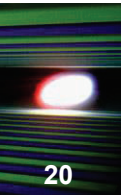


- Each SASE equipped with one **pump-probe laser**
 - R&D to overcome lack of commercially available systems
 - All essential features met: pulse length & power, pulse pattern and random pulse selection, wavelength tuning, diffraction-limited laser beam

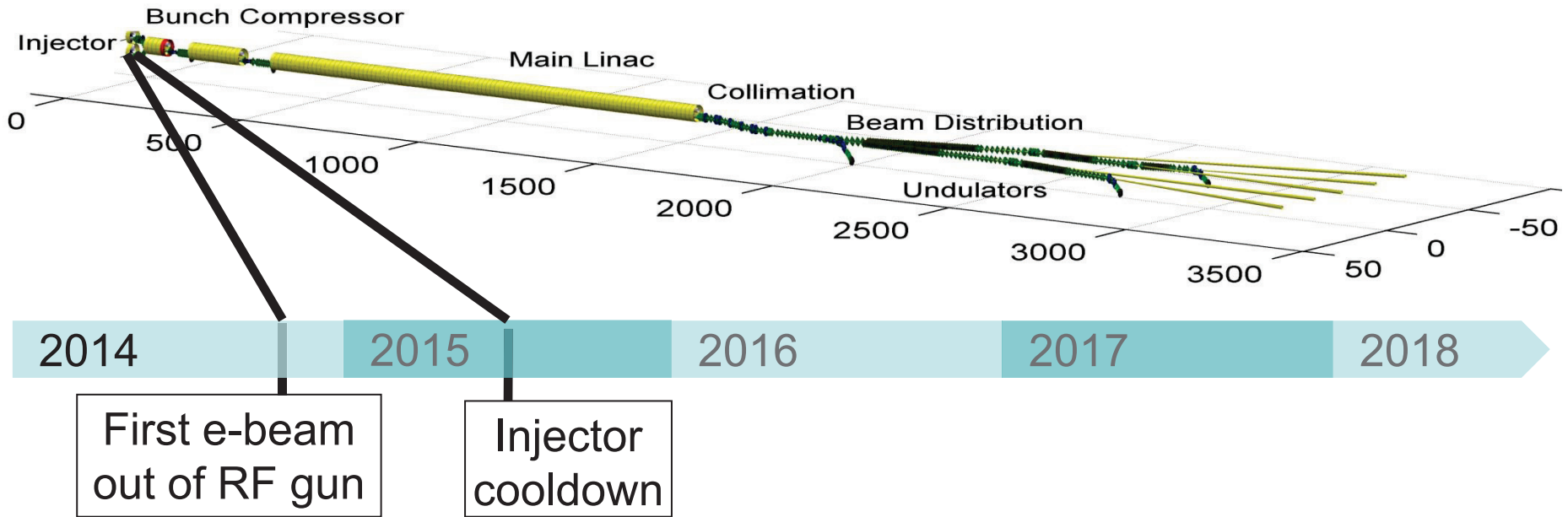
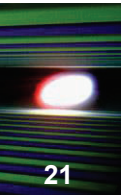
Outlook into commissioning and operation



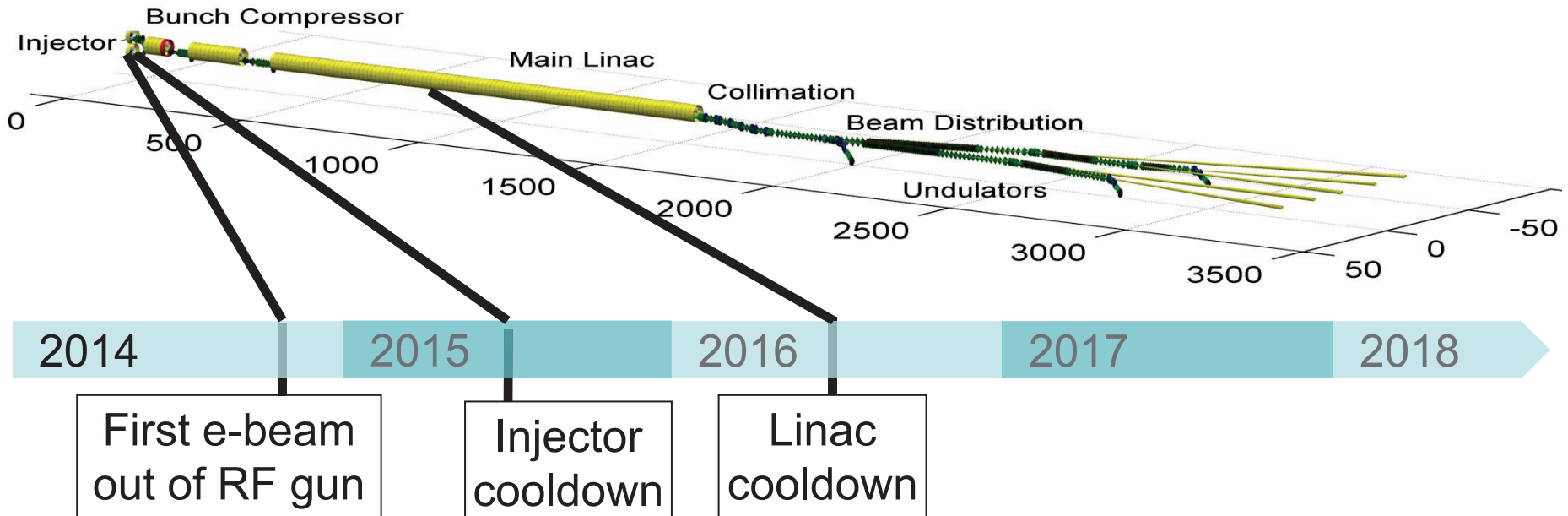
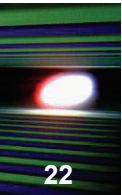
Outlook into commissioning and operation



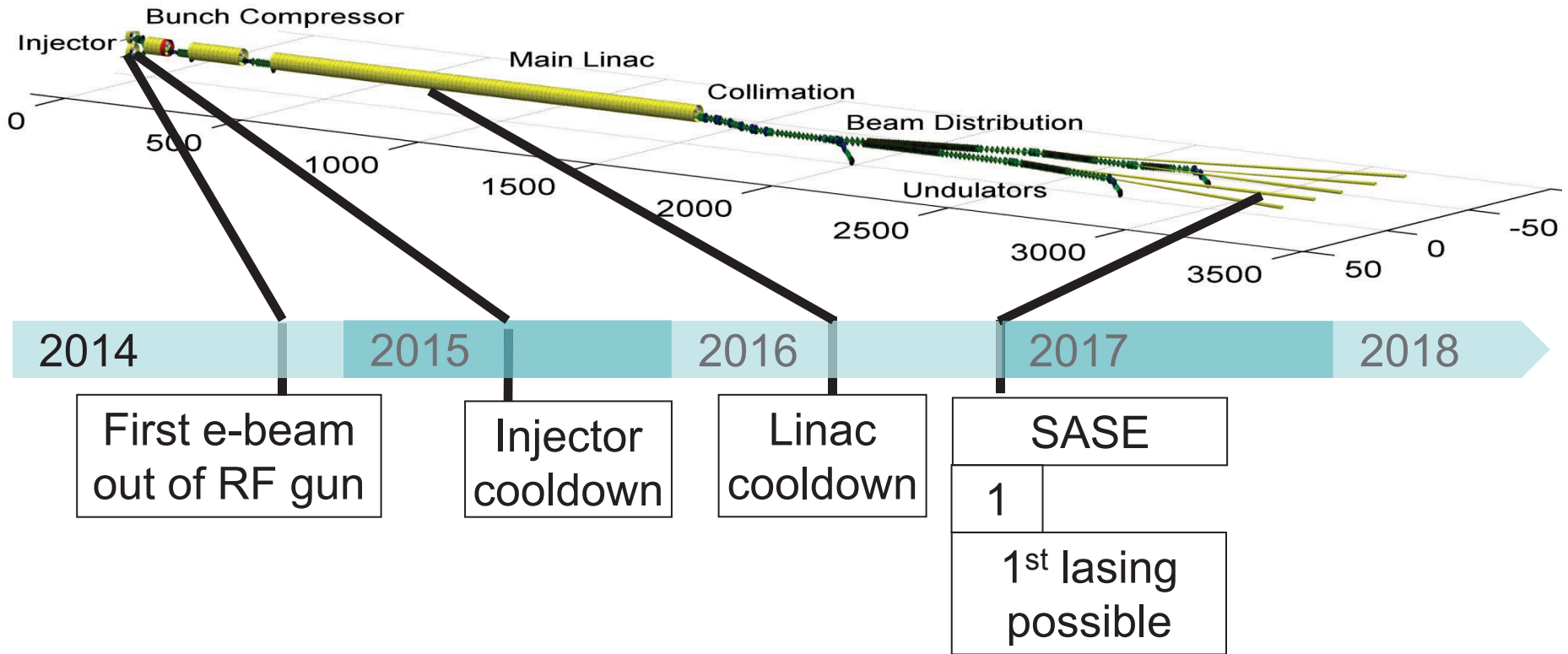
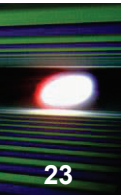
Outlook into commissioning and operation



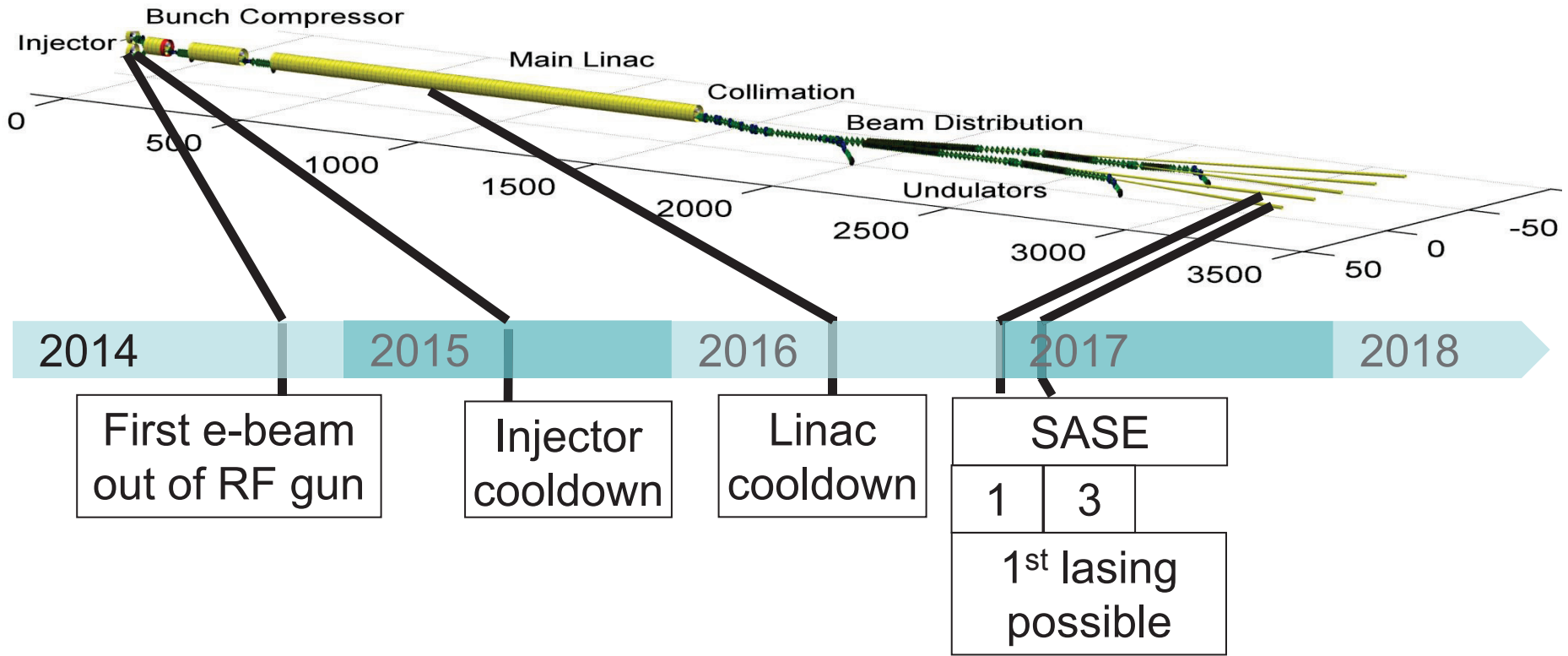
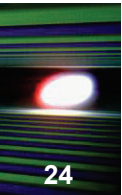
Outlook into commissioning and operation



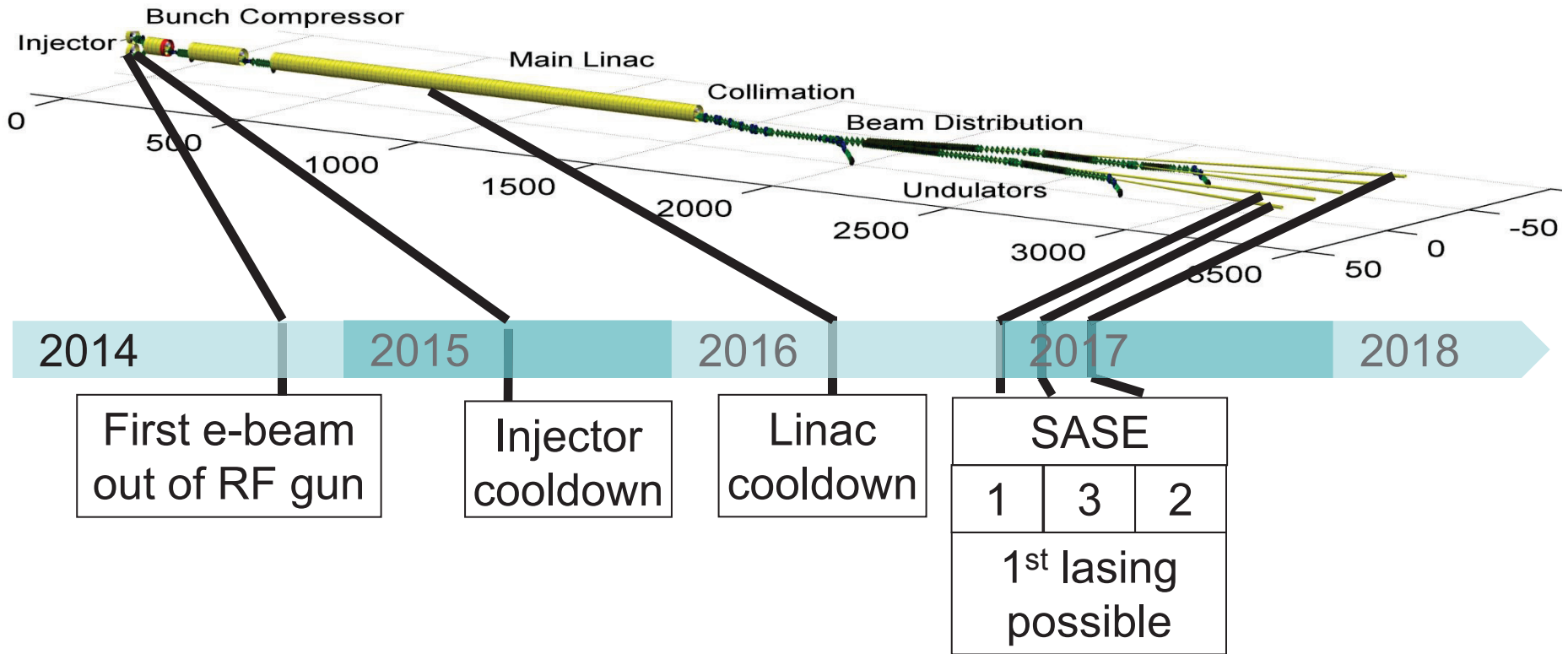
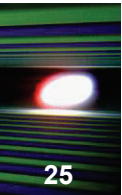
Outlook into commissioning and operation



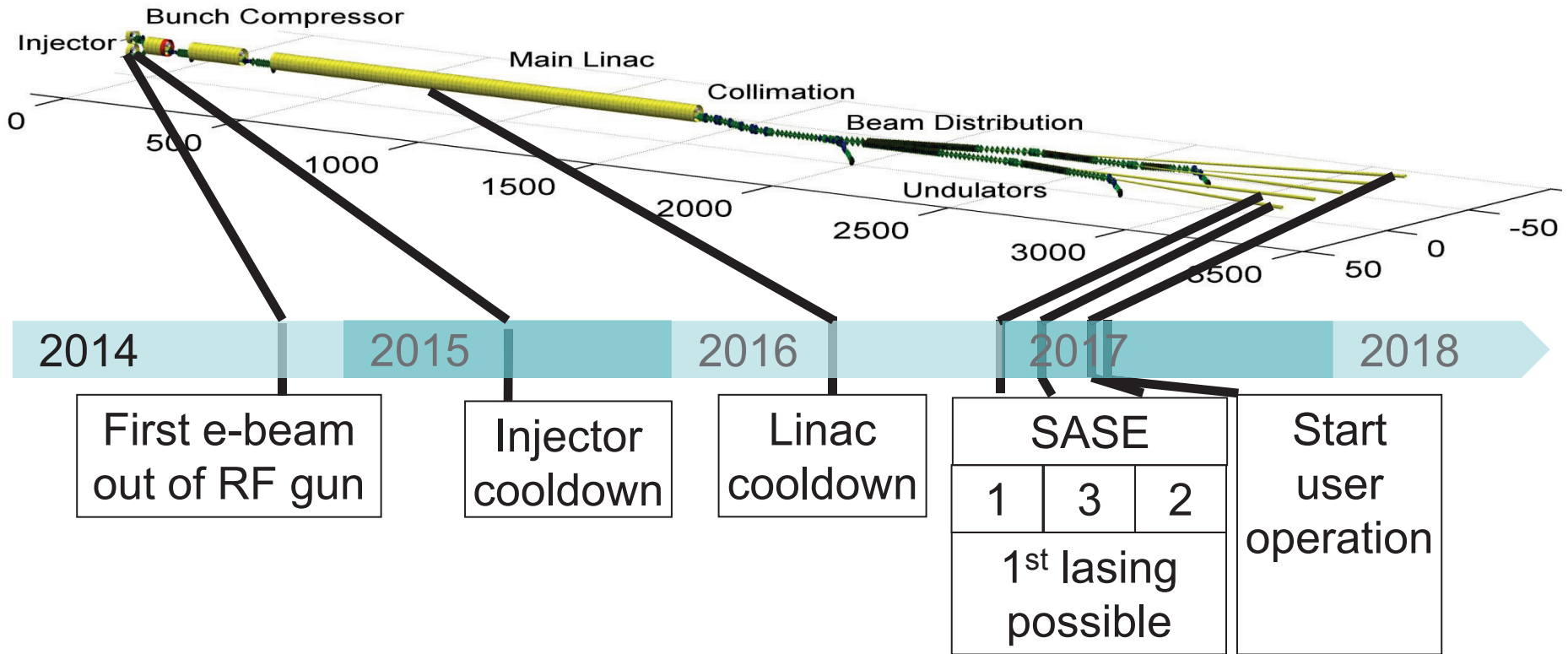
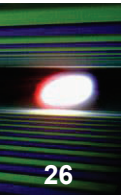
Outlook into commissioning and operation



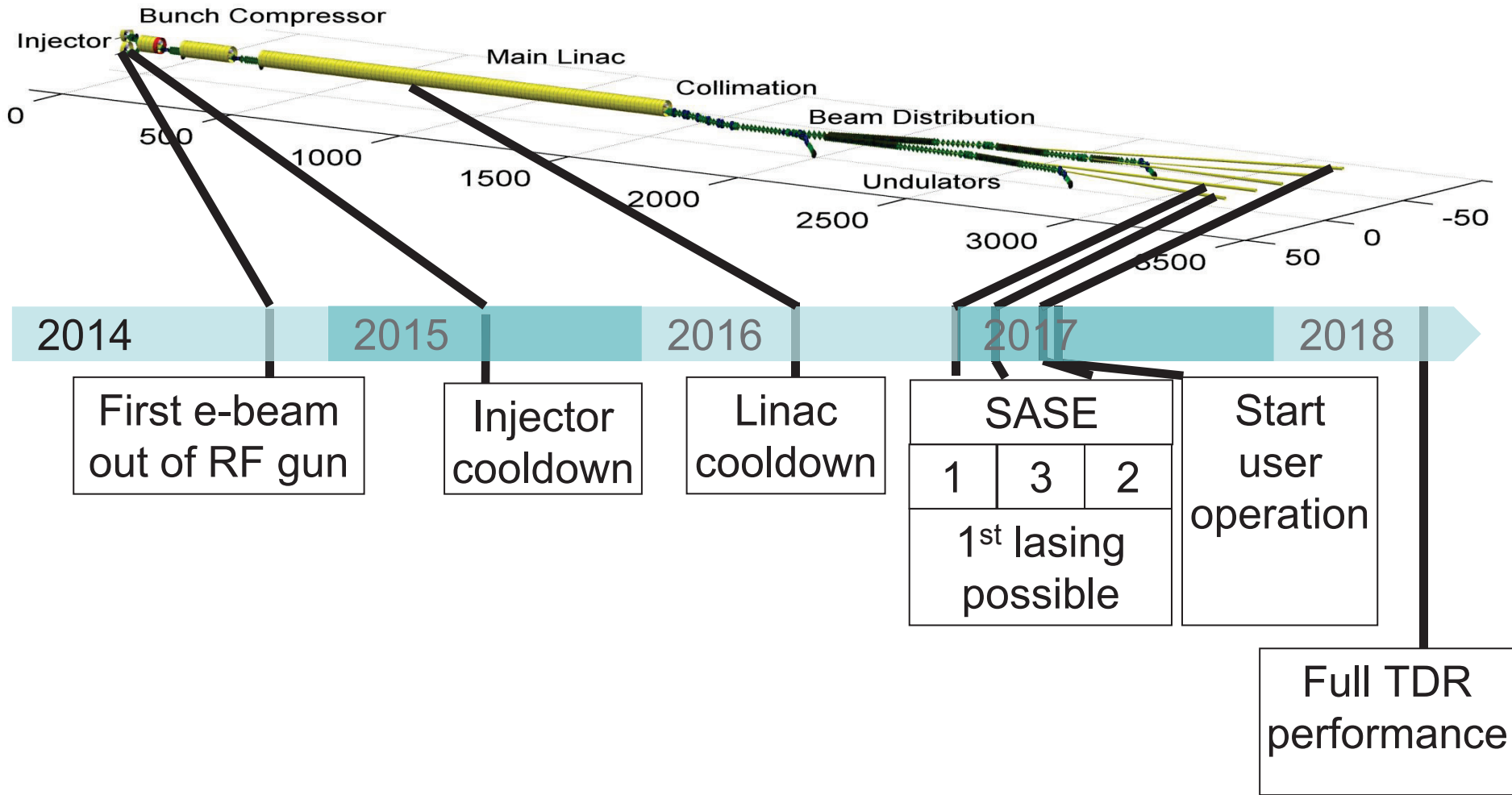
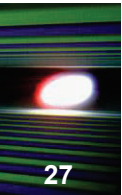
Outlook into commissioning and operation



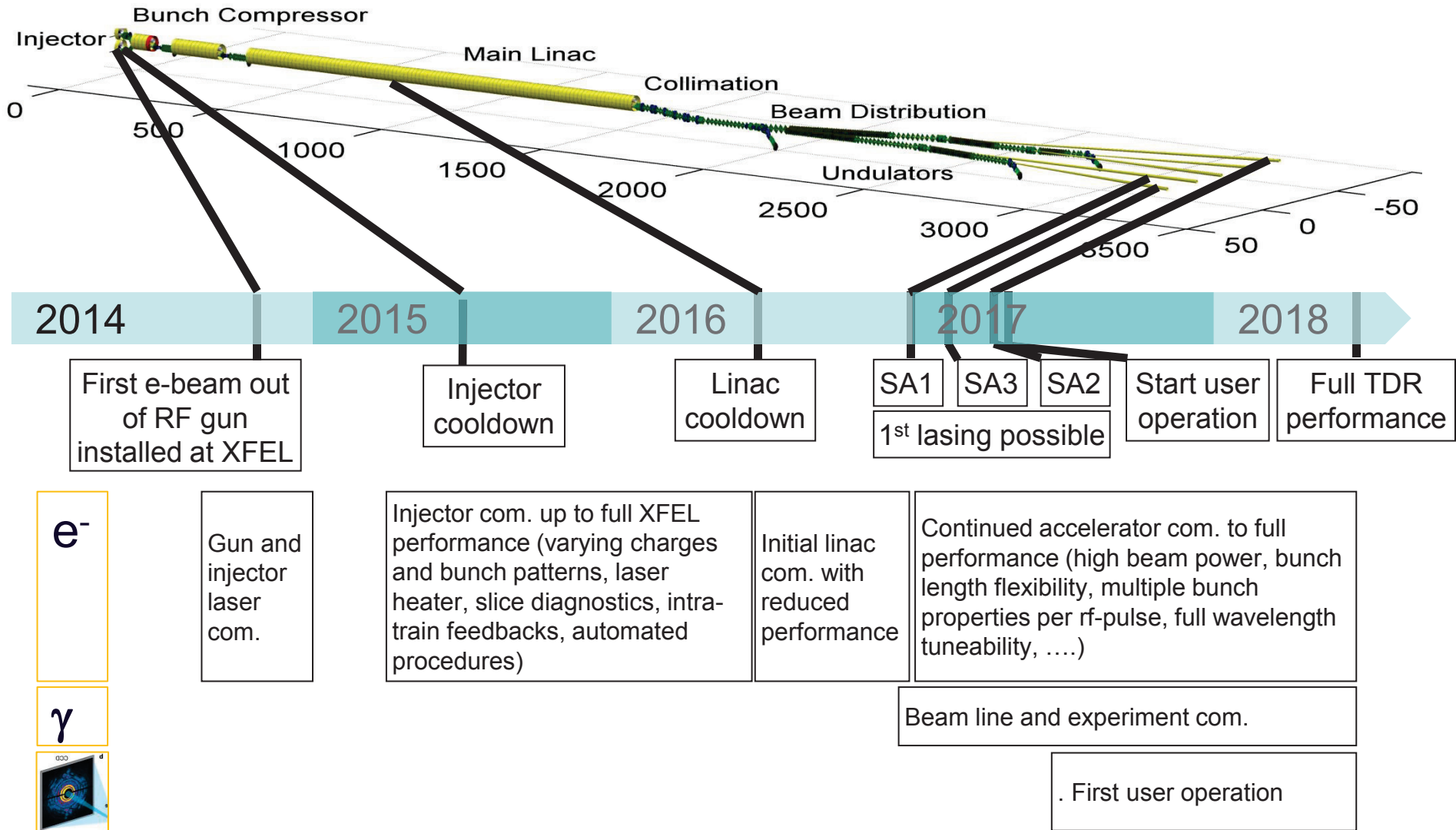
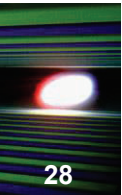
Outlook into commissioning and operation

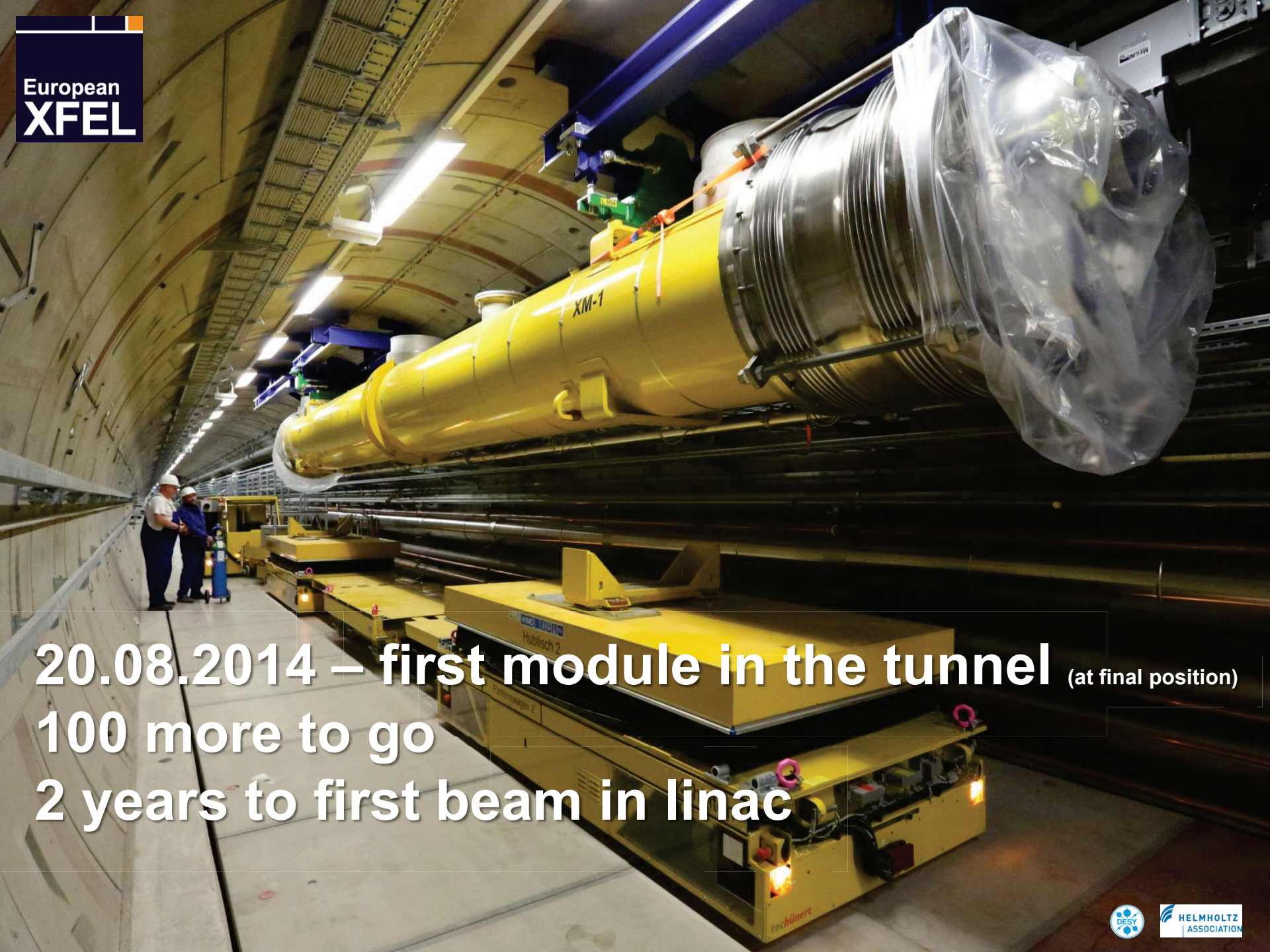


Outlook into commissioning and operation



Outlook into commissioning and operation





20.08.2014 – first module in the tunnel (at final position)
100 more to go
2 years to first beam in linac