



AMMW2013
workshop

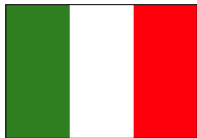
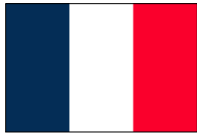
13. November 2013

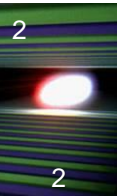
Kitty Fritz-Nielen

Introducing

European XFEL

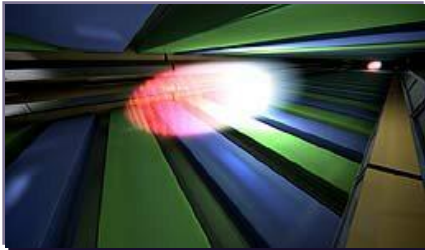
Enlightening Science



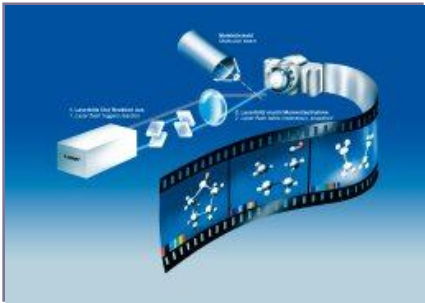


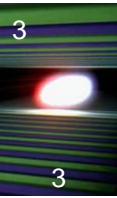
A new lightsource of superlatives

to explore the nanoworld with ultrashort X-ray flashes of unique properties and brilliance



- to investigate nanometer-scale structures, fast processes, and extreme states
- to take 3D images of viruses or proteins and film chemical reactions
- for applications in biology, chemistry, materials science, medicine, nanotechnology,...





About the project:

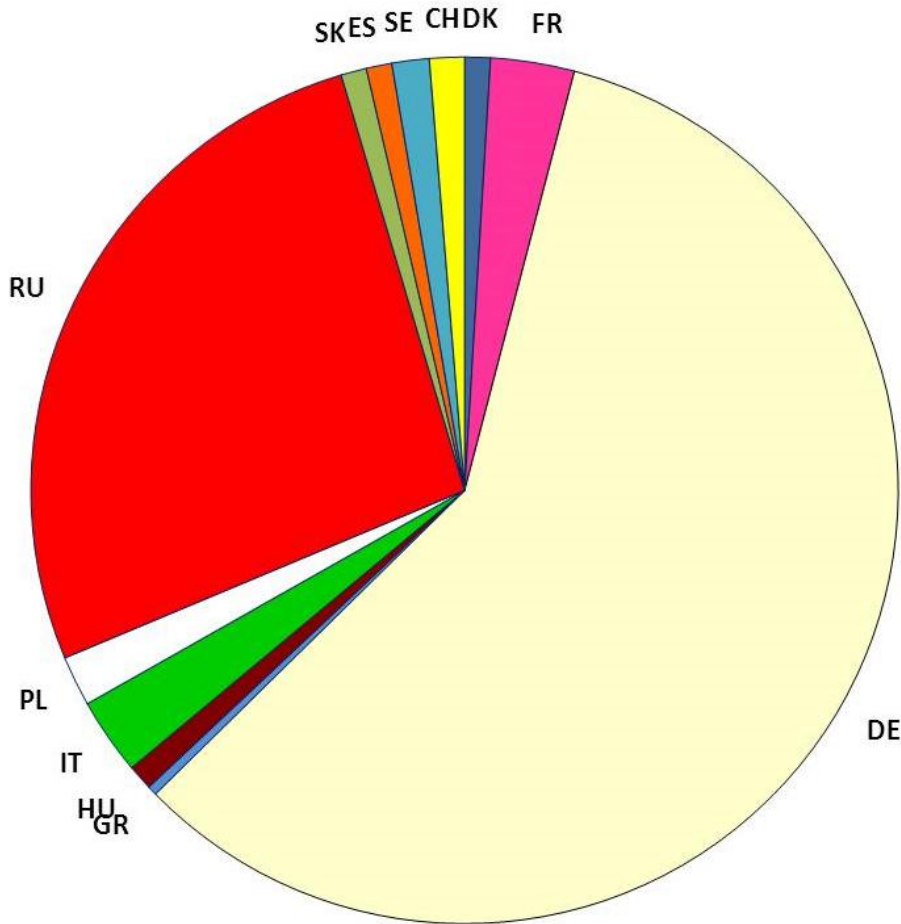
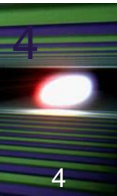


X-ray free electron laser (XFEL)

- Established as a non-profit organization in 2009
- Length: 3.4 km (5.8 km underground tunnels) with 1.7 km superconducting linear accelerator
- 3 sites (within the Hamburg metropolitan area)
- 5 beamlines, 10 instruments (starting with 3 beamlines and 6 instruments)
- Construction costs (incl. commissioning): 1150 M€ (2005 level); 12 participating countries (Germany 58 % and Russia 23 %)
- First beam planned in late 2015



12 countries contribute to the European XFEL



Each country contributes either:

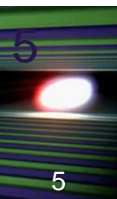
- in cash
- in-kind (equipment, manpower)
- or both












DESY leading contributor:

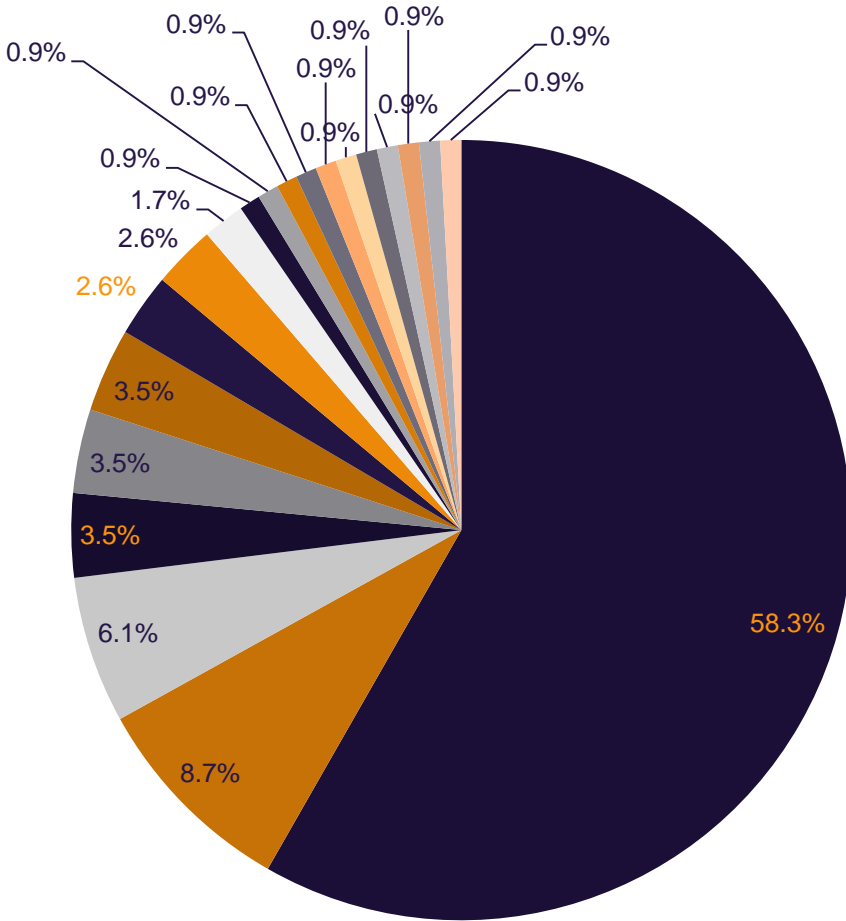
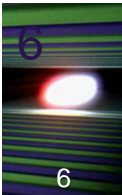
- Preparation tasks
- Host lab
- Accelerator Consortium Coordinator for manufacturing, integration & commissioning

The European XFEL Company is ultimately responsible for the:

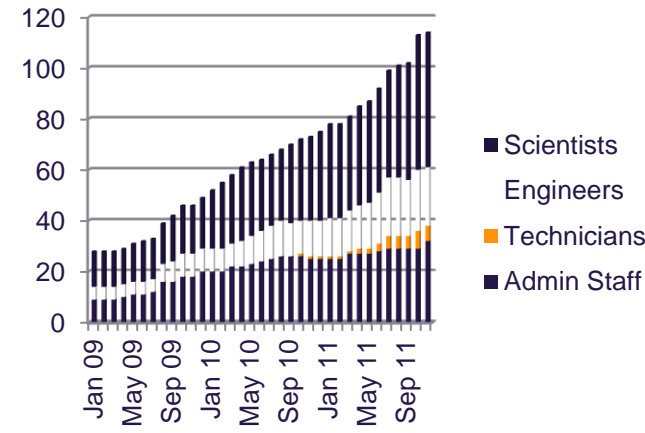
- Design, Construction, Commissioning & Operation of the XFEL facility



<u>DASTI</u>	Danish Agency for Science, Technology and Innovation		Denmark
CEA, CNRS	Commissariat à l'Energie Atomique et aux Energies Alternatives, Centre National de la Recherche Scientifique		France
<u>DESY</u>	Deutsches Elektronen-Synchrotron		Germany
<u>NIH</u>	National Innovation Office		Hungary
MIUR	Ministero dell'Istruzione, dell'Università e della Ricerca		Italy
<u>NCBJ</u>	National Centre for Nuclear Research		Poland
<u>RUSNANO</u>	Russian Corporation of Nanotechnologies		Russia
<u>MINEDU</u>	Ministry of Education		Slovakia
MINECO	Ministry of Economic Affairs and Competitiveness		Spain
<u>VR</u>	Vetenskapsrådet, Swedish Research Council		Sweden
<u>SER</u>	State Secretariat for Education and Research		Switzerland



- Germany
- Russian Federation
- Italy
- China
- Poland
- Spain
- France
- United States
- Iran
- Algeria
- Australia
- Bolivia
- Cameroon
- Denmark
- India
- Indonesia
- Portugal
- Turkey
- Ukraine
- United Kingdom



Forecast of staff growth:
 End 2012: 180
 End 2013: 210
 End 2014: 240

Council



Chair: Robert Feidenhans'l

(University of Copenhagen, Denmark)

The European XFEL Council is the supreme organ of the company in which up to two delegates represent the shareholders of each contracting party.

Accelerator Consortium

Chair: Hans Weise, DESY

DESY

IKC: RF System, LLRF, AMTF,
and more

University Uppsala

IKC: Laser heater, personnel,
injector

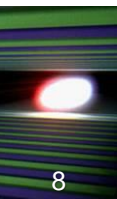
European X-Ray Free-Electron Laser Facility GmbH

Management Board:

Massimo Altarelli
Claudia Burger
Sergei Molodtsov
Andreas Schwarz
Thomas Tschentscher

Design, construction,
commissioning and
operation of X-ray
systems

14 technical/scientific groups
4 administrative groups
Technical services

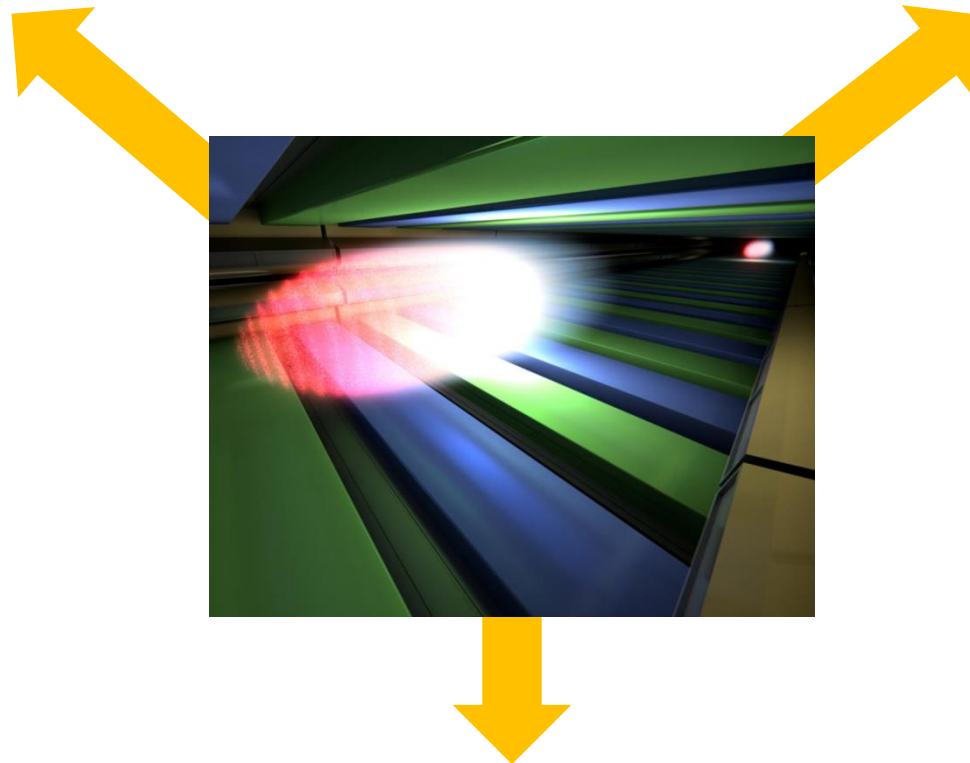


X-ray light

See samples at atomic resolution

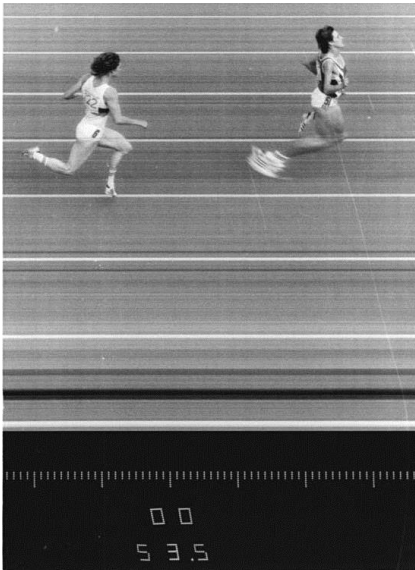
Ultrashort flashes

Film (bio-)chemical reactions



Intense X-ray pulses

Study single molecules or tiny crystals

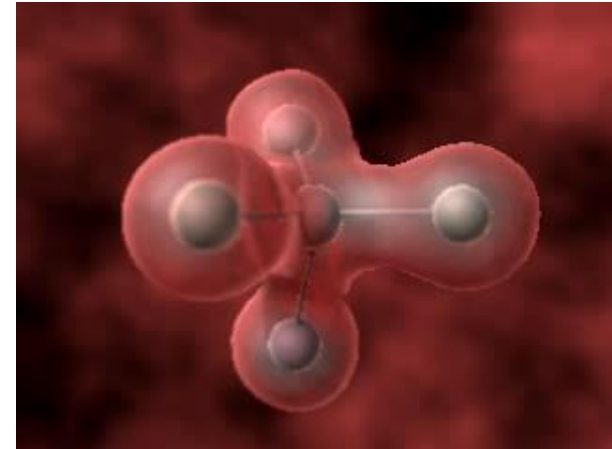


Bundesarchiv, Bild 183-1987-0822-034 / CC-BY-SA

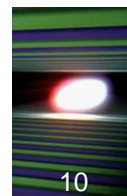
1/1.000 s



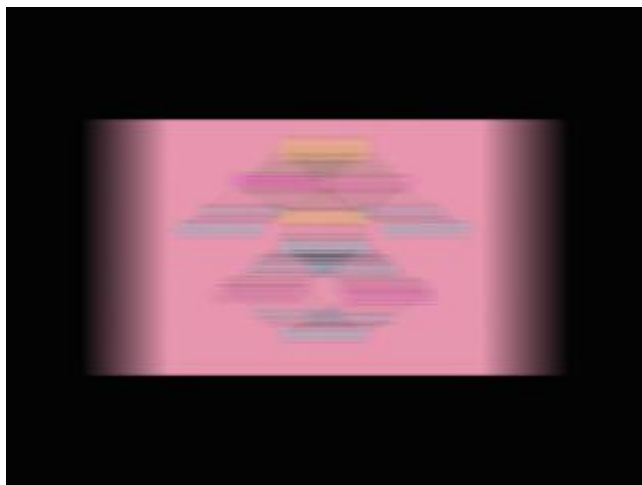
1/1.000.000 s



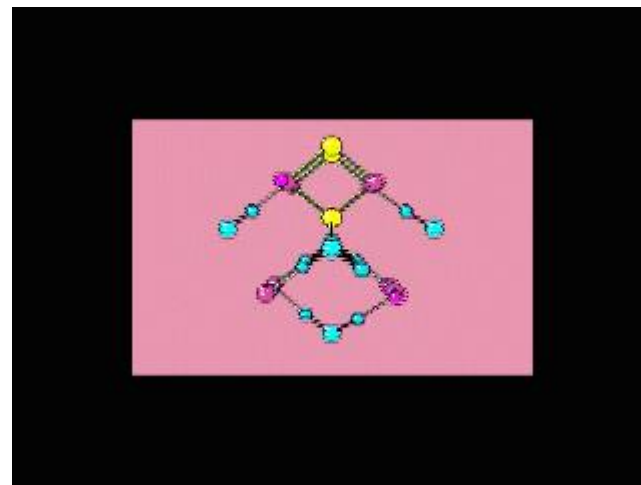
**1/10.000.000.000.000 s
= 100 femtoseconds**



Imaging at low time resolution ($\gg 100$ fs)



Imaging at European XFEL's time resolution (< 100 fs)



- ***Higher time resolution allows for clearer “movies” that show molecular motion, not just the location of the atoms***
- ***New way of seeing chemical reactions and molecular reconfigurations***



Biology, medicine, and pharmacology

- Direct observation of the action of enzymes
- Implications for engineering of medications



Physics

- Quantum behavior of electrons
- Better understanding magnetism and superconductivity



Chemistry

- Filming chemical reactions
- Physics of molecular bonding



Astrophysics and the science of extreme states

- Mimicking the conditions inside stars



Materials science

- Better understanding crystal structure
- Engineering stronger structures

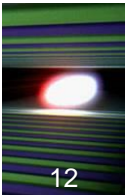


Photonics

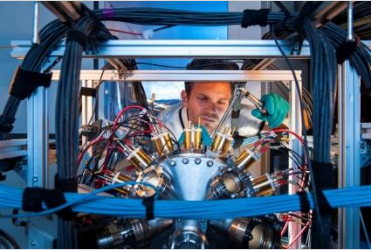
- Better understanding the properties of light



.....And many other, yet unknown possibilities



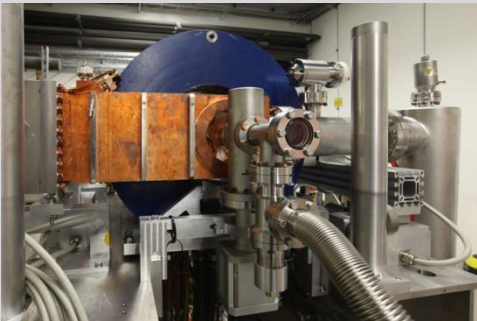
Scientific instruments & ancillary instrumentation



X-ray optics & beam transport



Electron injector

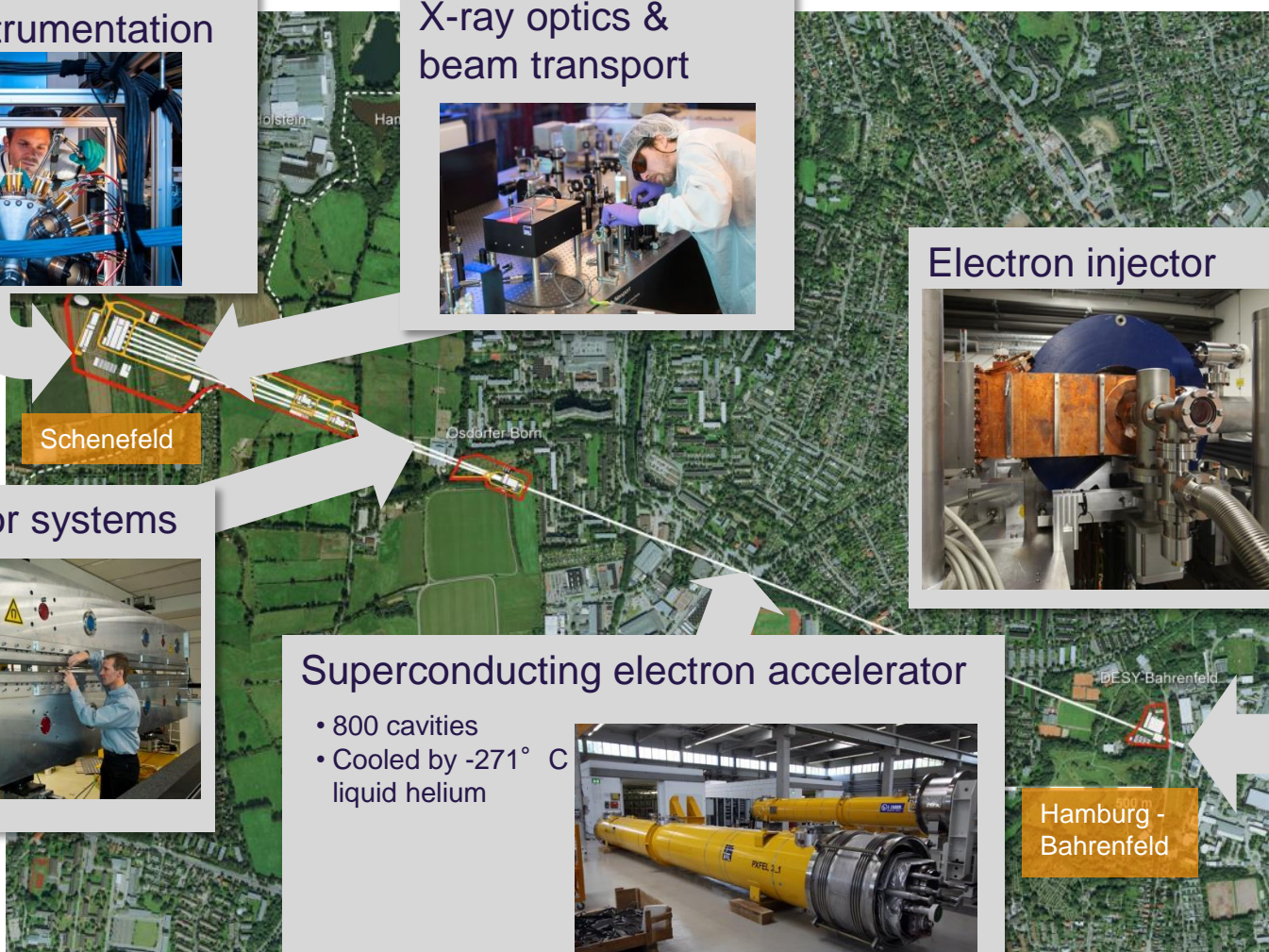


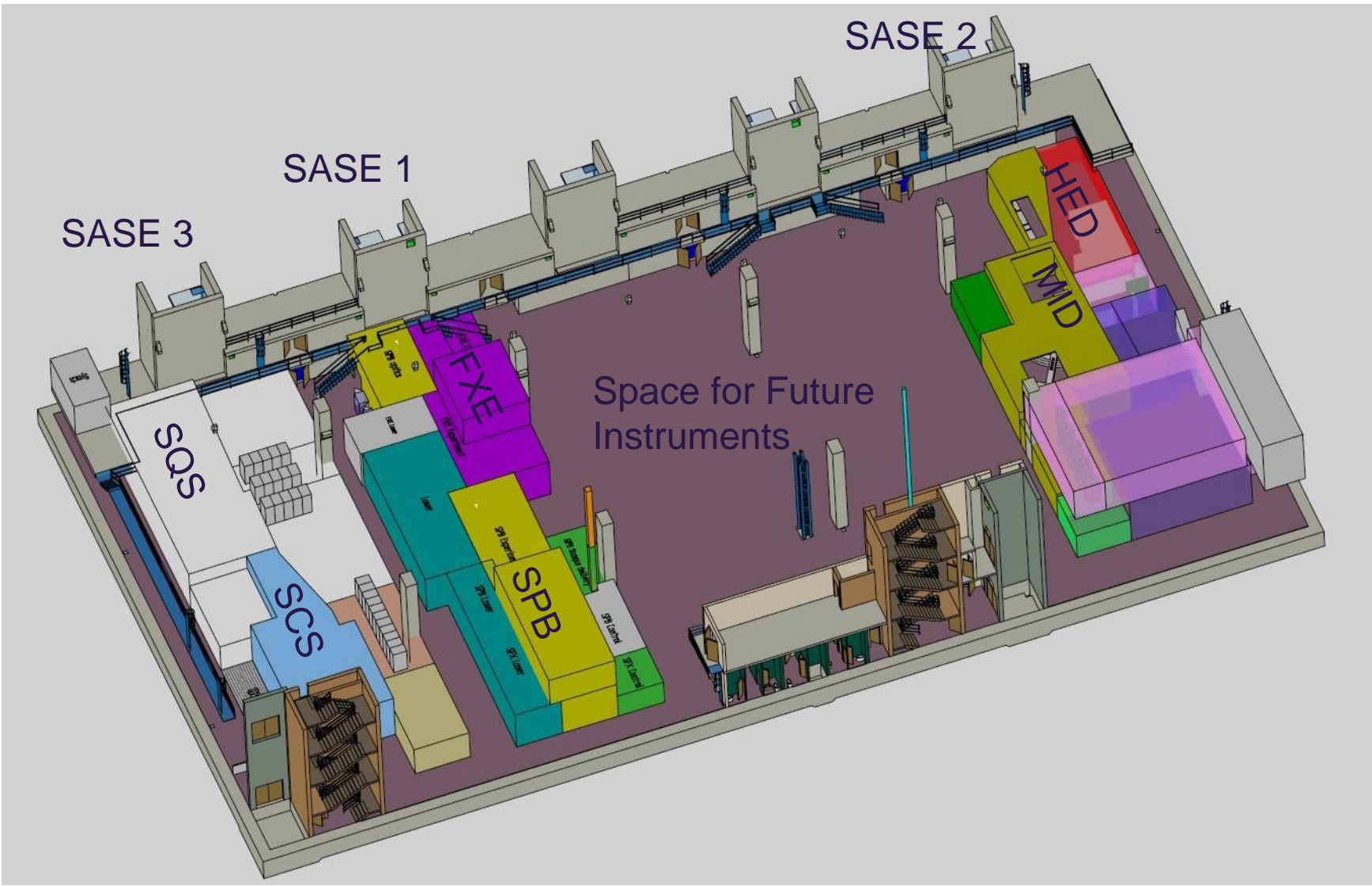
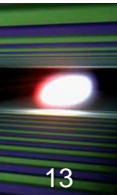
Undulator systems



Superconducting electron accelerator

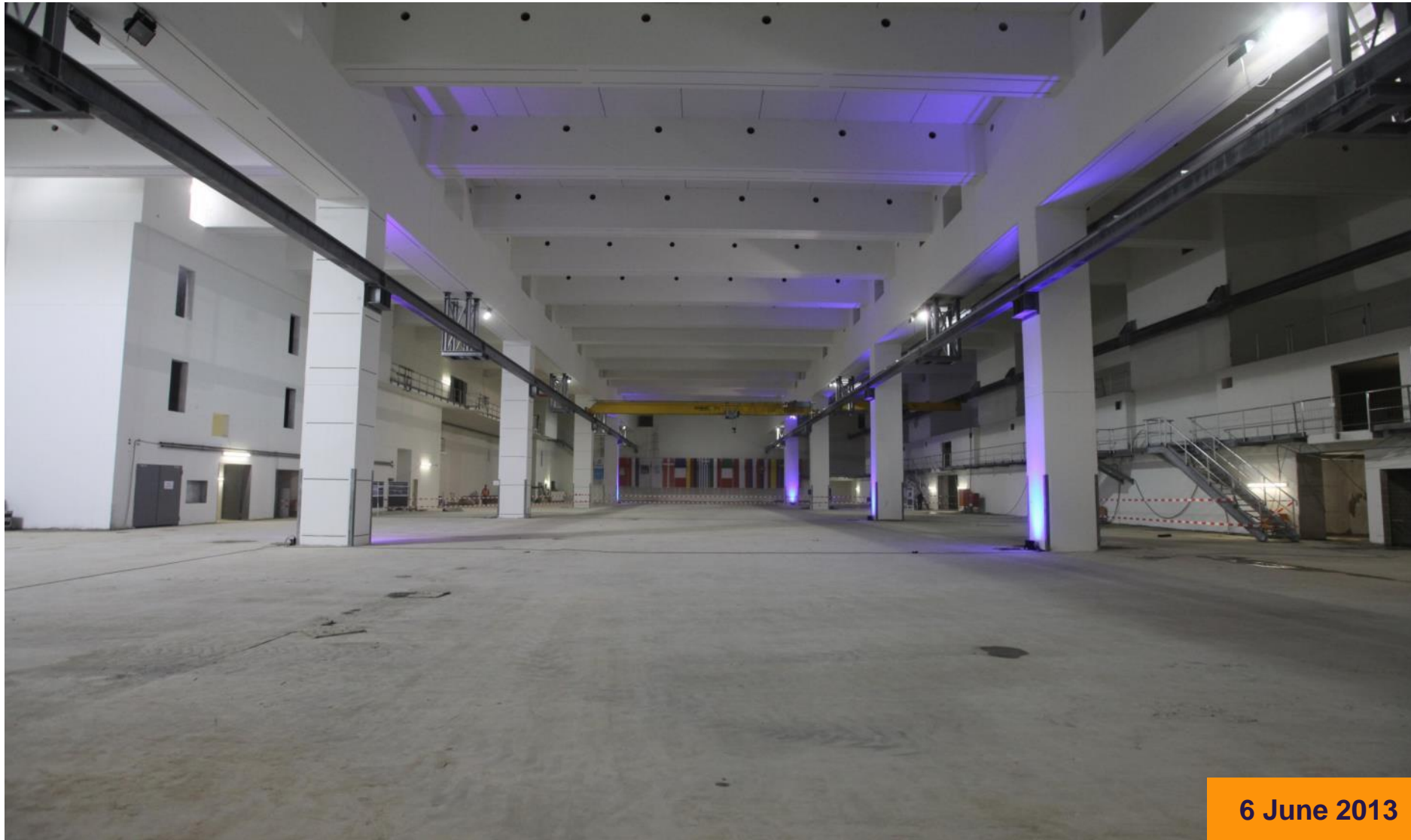
- 800 cavities
- Cooled by -271°C liquid helium



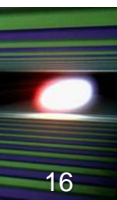




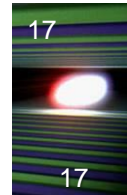
Completed underground construction of Experiment hall

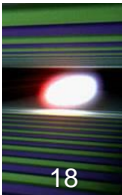


6 June 2013



10 April 2013

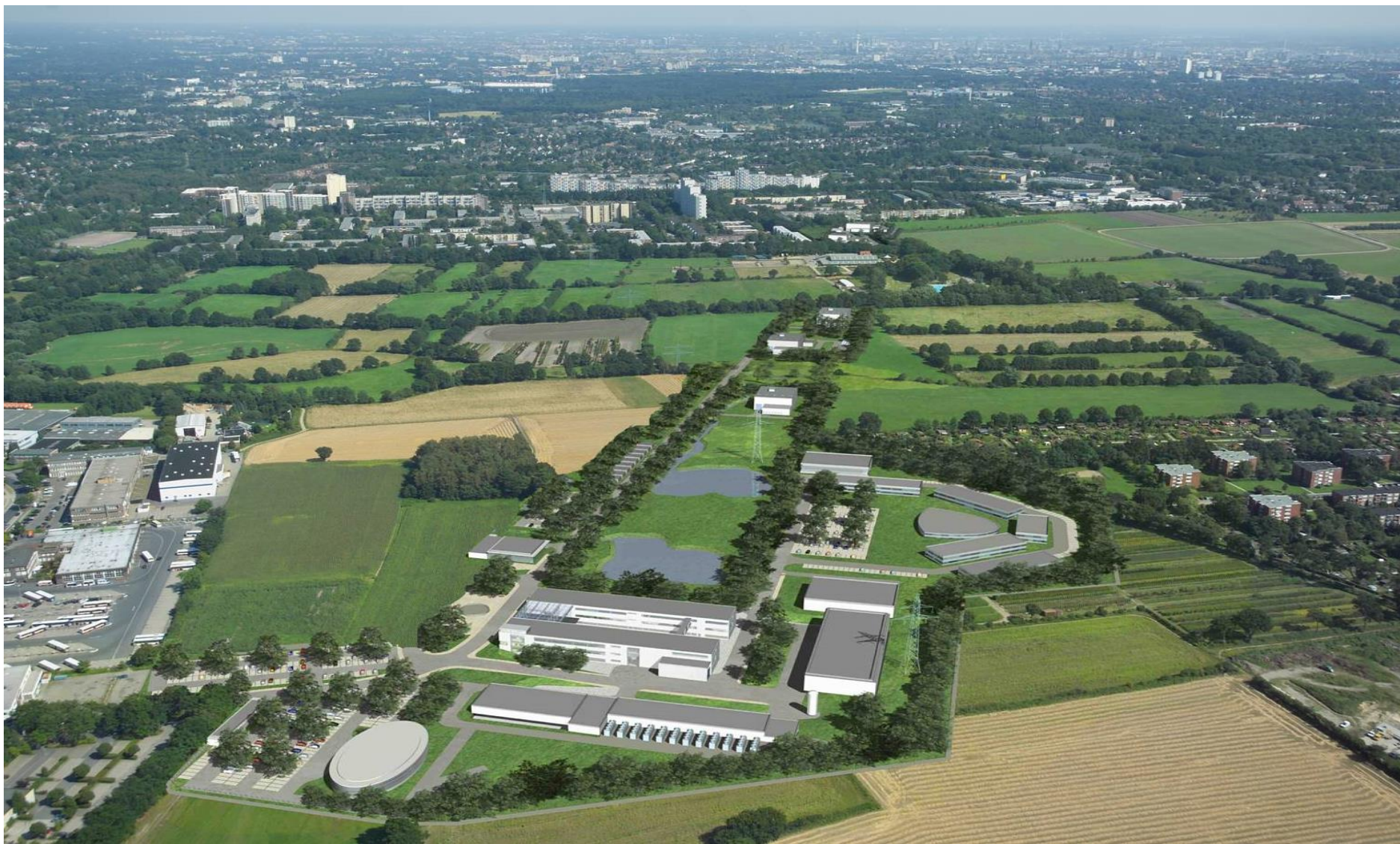
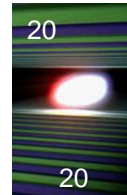




25 July 2012



1 October 2012



Thank you very much!