

# Developments in Europe

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KEK, 28 September 2017



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# Topics

- The European strategy process
- XFEL status
- SCRF at DESY and in Europe
- ILC European Action Plan
- NDA with DESY

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# The European Strategy for Particle Physics

- <https://council.web.cern.ch/en/content/european-strategy-particle-physics>:

*The Convention bestows two missions upon the Organization, namely the operation of laboratories and the organisation and sponsoring of international co-operation in the field of elementary particle physics.*

*[...] In this context, the Council has assumed full responsibility for defining the strategic orientations of European particle physics, a bottom-up process that starts with the broad consultation of all stakeholders in Europe's particle physics community and culminates in a dedicated meeting of the European Strategy Group, which brings together representatives of the CERN's Member States and of the major European laboratories active in the field, particle physicists from outside Europe and specialists in related fields of physics.*

*The Strategy updates are drafted at this special "drafting" session of the European Strategy Group and are then validated at a dedicated "European Strategy Session" of the Council. The last one of these was held on 28 May 2013 in Brussels.*

# The European Strategy for Particle Physics

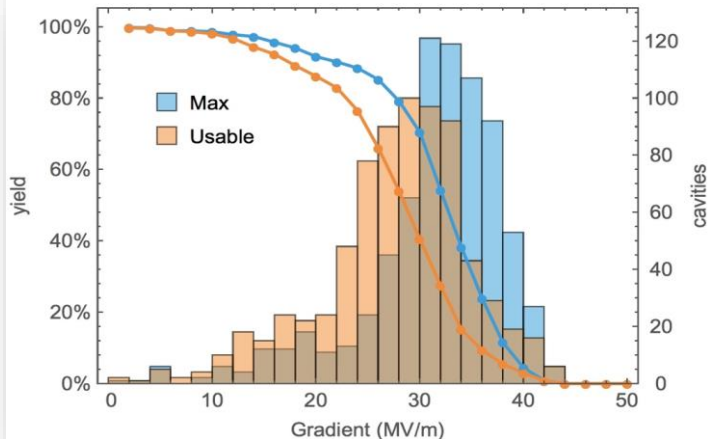
- Potential timeline (in blue my guess, based on 2013 strategy update)
- In fact, CERN Council will decide today about Scientific Secretary for next strategy update.
  - May 2018: Approval of strategy secretary's update plan by Council.
  - Until mid-2019: Submission of input to open symposium
  - Autumn 2019: Open symposium
  - Autumn 2019: Preparation of briefing book for European Strategy Group by European Strategy Preparatory Group
  - Early 2020: Drafting of European strategy update by ESG
  - March 2020: Finalisation of European strategy update by Council
  - May 2020: Adoption of strategy update by Council

# Topics

- The European strategy process
- XFEL status (courtesy H. Weise / European XFEL)
- SCRF at DESY and in Europe
- ILC European Action Plan
- NDA with DESY

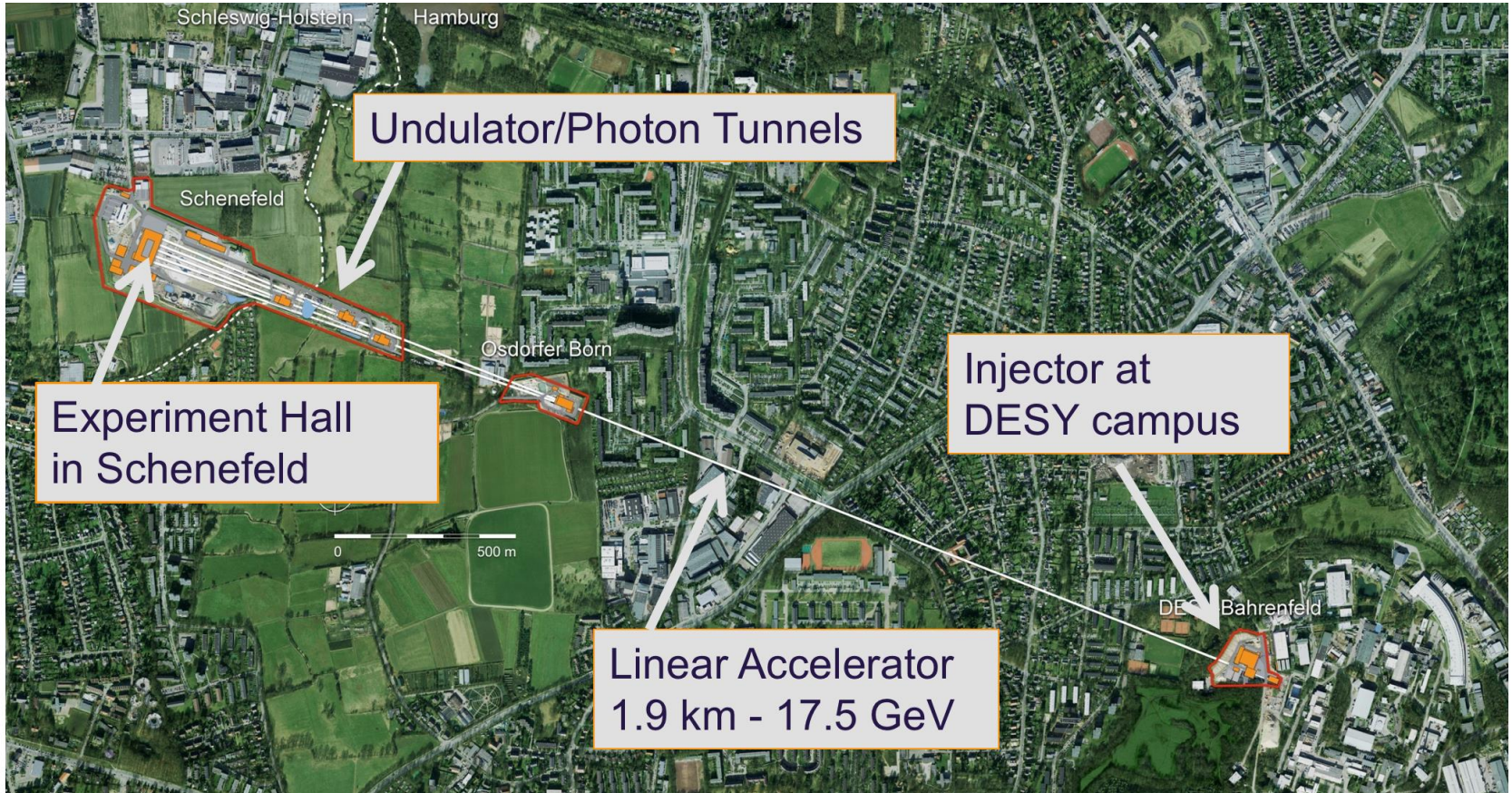
# European XFEL: Reminder

- 2.1 km 17.5 GeV SCRF linac
- First light: May 2017
- User operation since ... now
- 800 cavities in 100 modules
- Current energy: 14.6 GeV





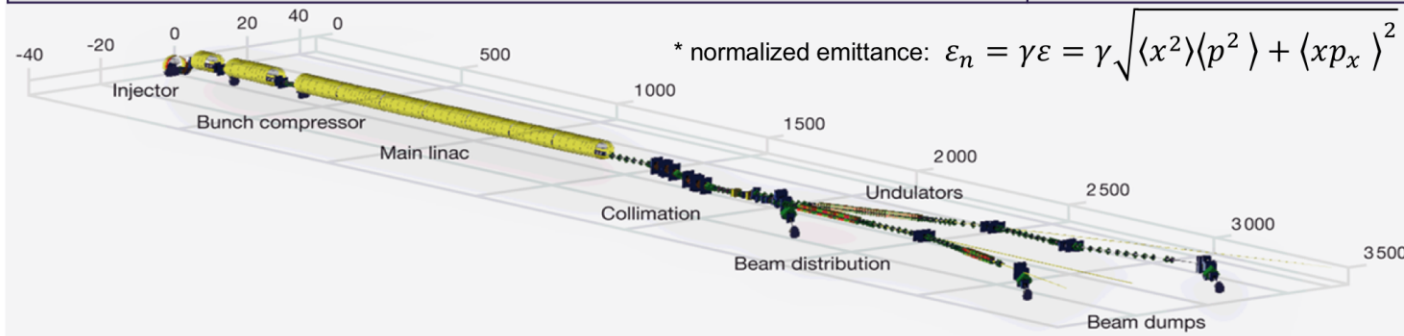
# European XFEL: Layout



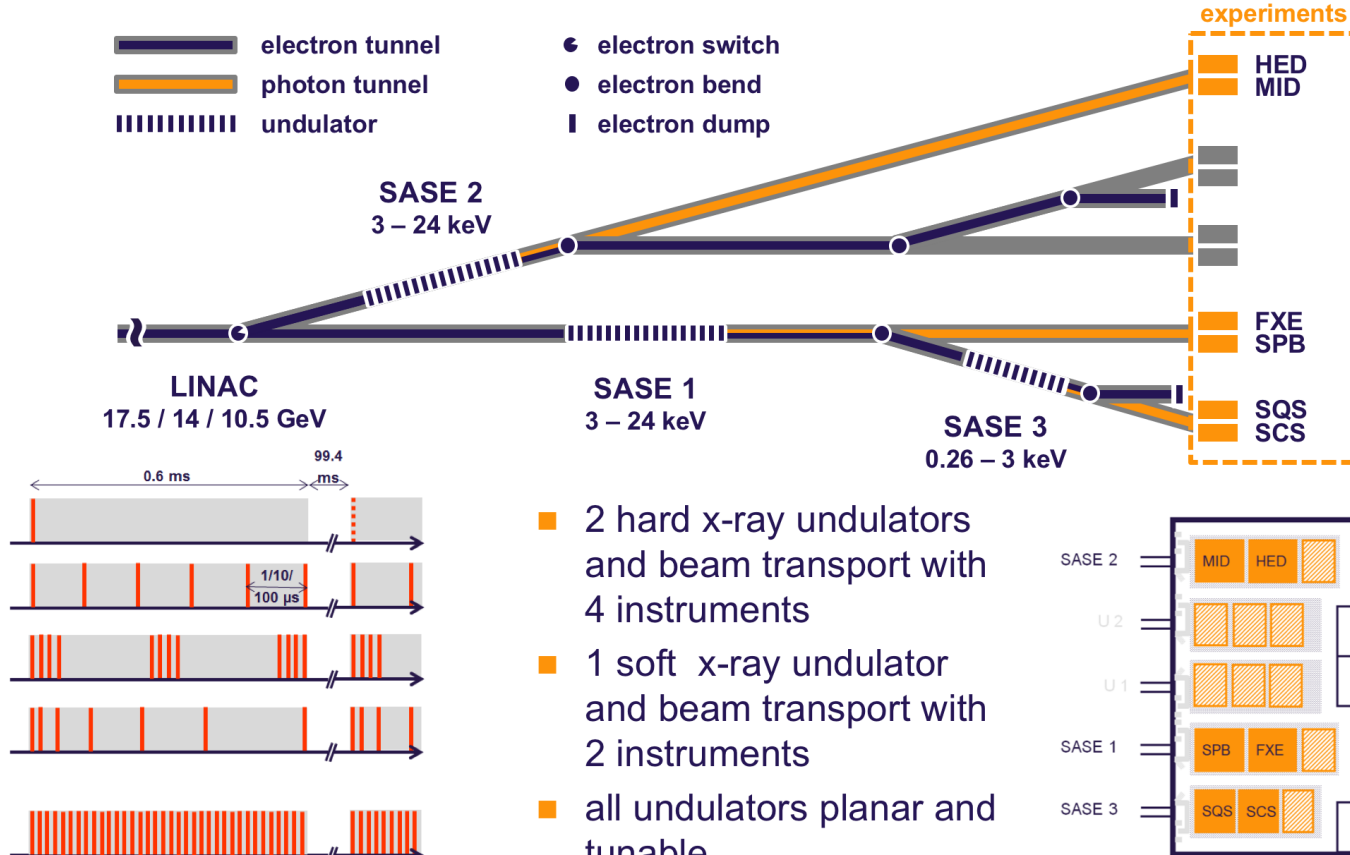


# European XFEL: Challenging parameters

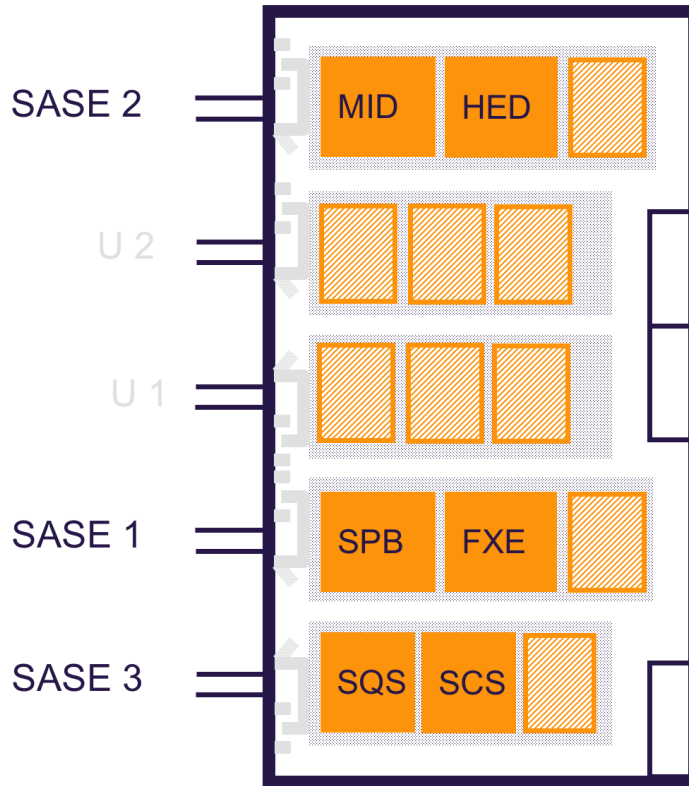
electron beam energy	8/12.5/14/17.5 GeV
macro pulse repetition rate	10 Hz
RF pulse length (flat top)	600 $\mu$ s
# of bunches/second	27,000
bunch charge	0.02 – 1 nC
electron bunch length after compression (FWHM)	2 – 180 fs
normalized slice emittance*	0.4 - 1.0 mm mrad
beam power	500 kW
simultaneously operated SASE undulators	3



# Different wavelengths and time structures



# European XFEL: Suite of instruments



**FXE** Femtosecond  
X-ray  
Experiments

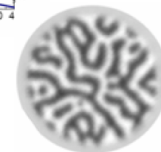
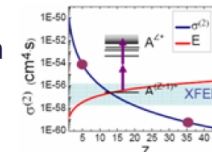
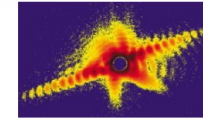
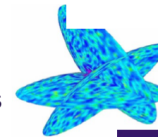
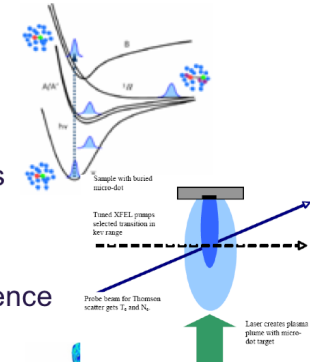
**HED** High Energy  
Density Science

**SPB** Single Particle &  
Biomolecules

**MID** Materials Imaging &  
Dynamics

**SQS** Small Quantum  
Systems

**SCS** Spectroscopy &  
Coherent Scattering



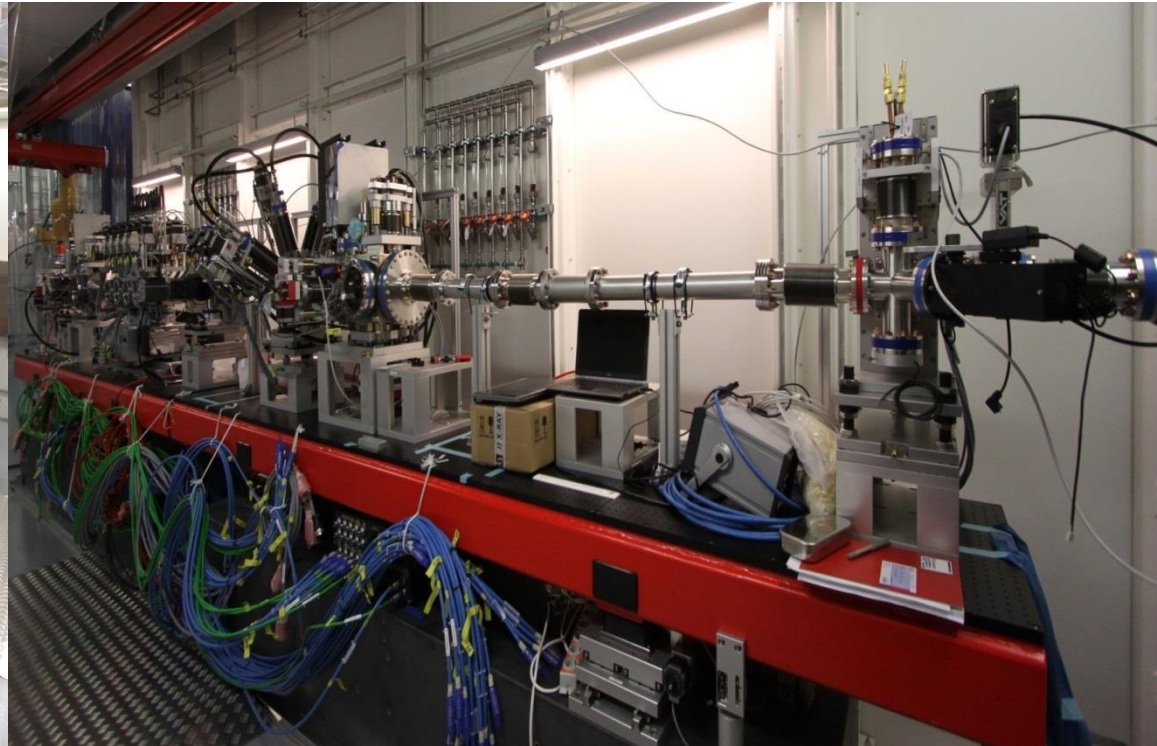
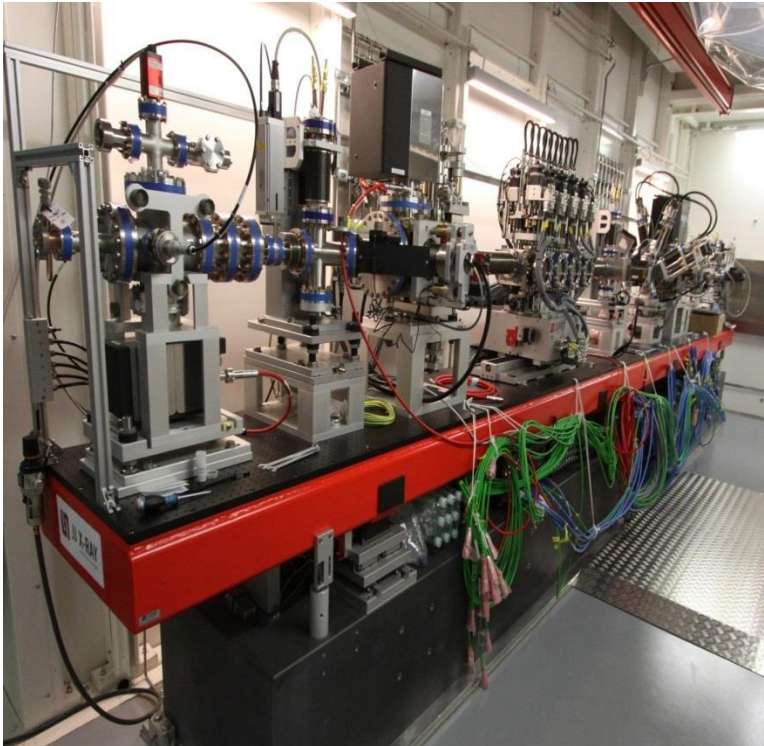
# Status of the European XFEL

- 17 September 2017: First users at the XFEL experimental stations
- FXE (Femtosecond X-Ray Experiments)
  - Research of extremely fast processes (“molecular movies”)
  - Spectroscopic methods for ultrafast processes as a start
- SPB/SFX (Single Particles, Clusters, and Biomolecules and Serial Femtosecond Crystallography)
  - Shape / function of biomolecules
  - Method development; reduction of sample amounts; Melbourne virus; water splitting process in photosynthesis
- 14 groups with up to 80 researchers until March 2018
  - Beam time up to 5 days.

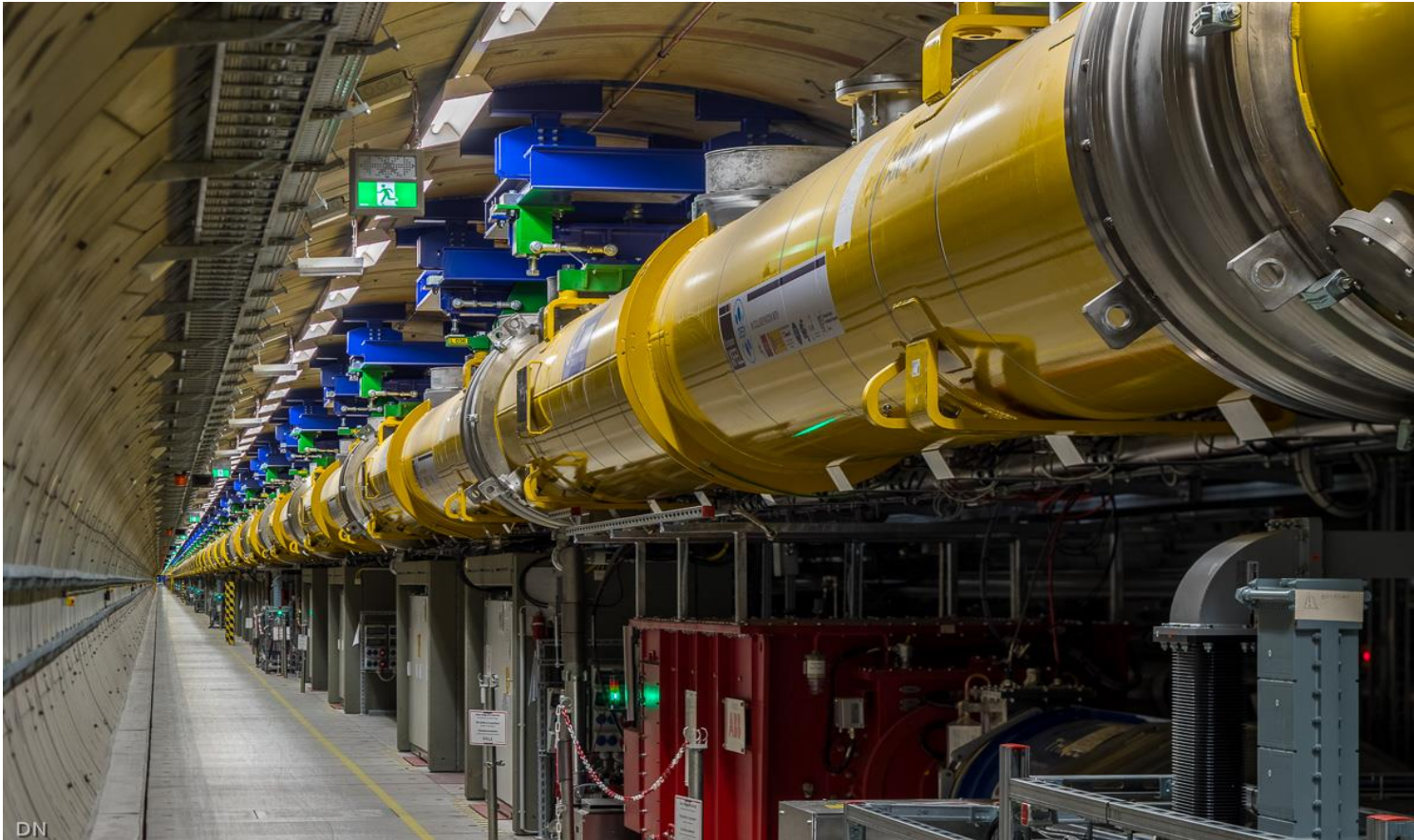




# European XFEL: SASE 1 instrument FXE

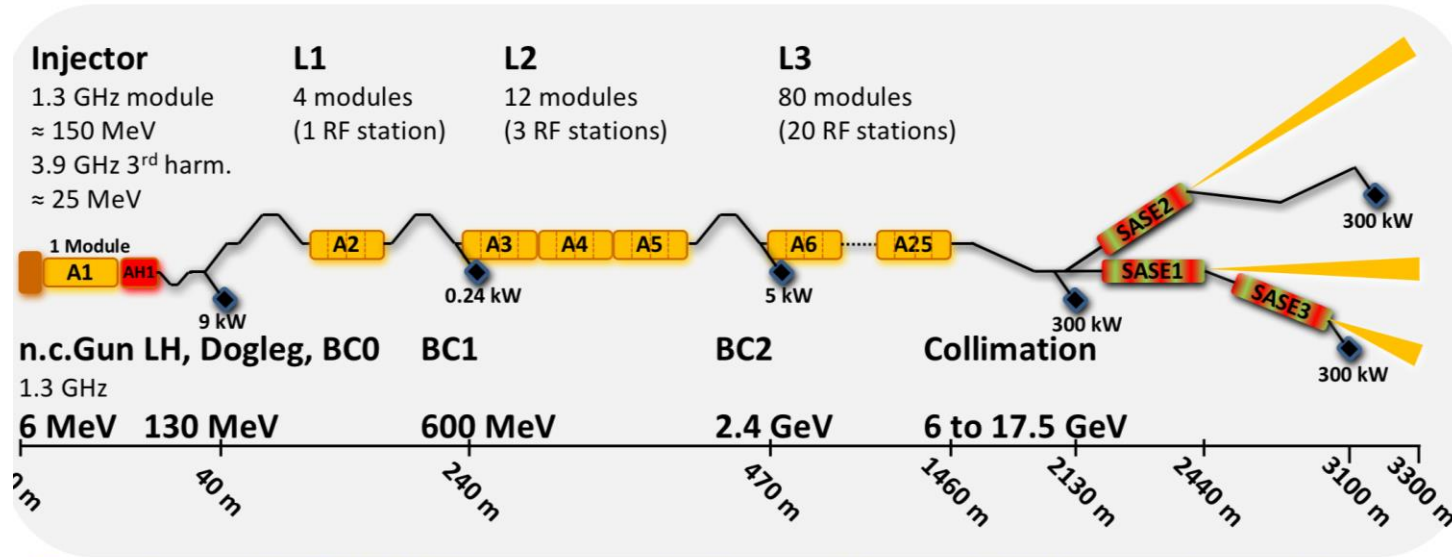


# European XFEL: View along L3 accelerator section



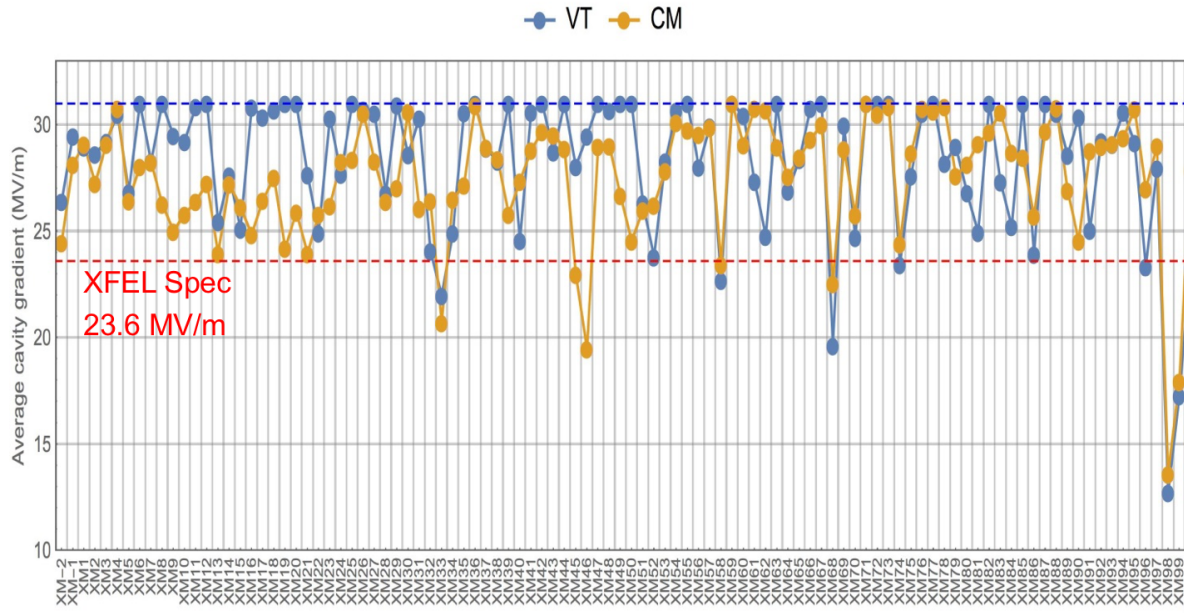


# European XFEL: Accelerator overview



- s.c. linac with 97 1.3 GHz superconducting modules + 1 third harmonic module
- design gradient: 23.6 MV/m; pulsed with 1.4ms pulse length; 600  $\mu$ s flat top
- 4 modules / 32 s.c. cavities are connected to one 10 MW klystron (“RF station”)
- 12 modules form a cryogenic string
- Down to app. 50m behind the last module the complete beam vacuum is “particle free”

# European XFEL: Module performance

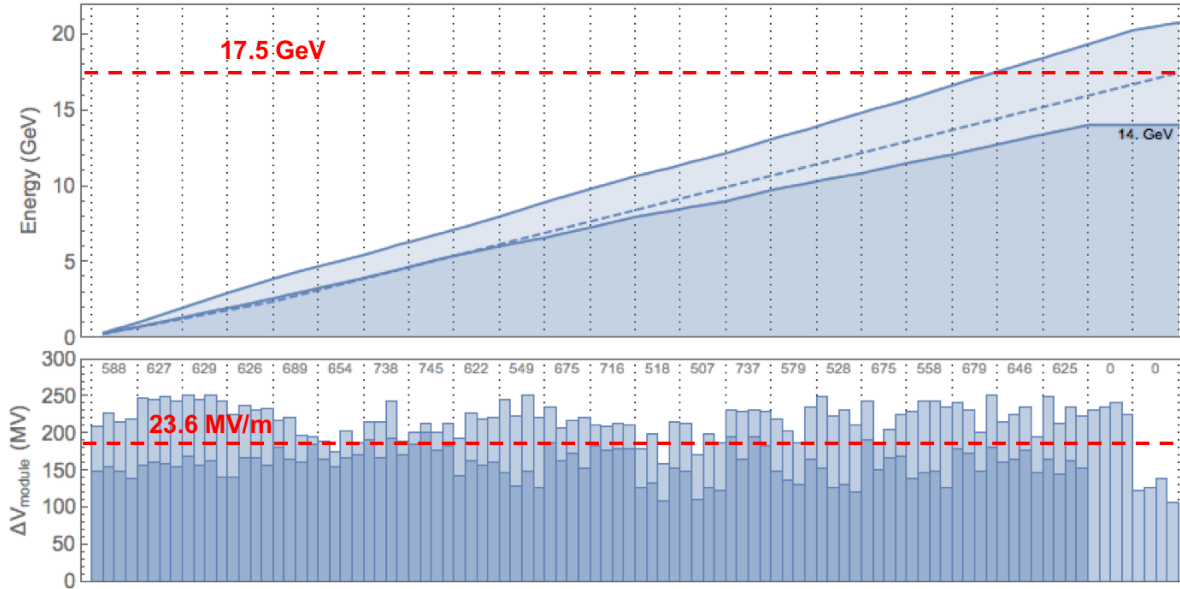


- Module performance well above specs. and visible improvement with time
- Tunnel installation used sorting of modules based on AMTF performance
- XM98 as scavenger module

vertical test (clipped at 31 MV/m)  
module performance

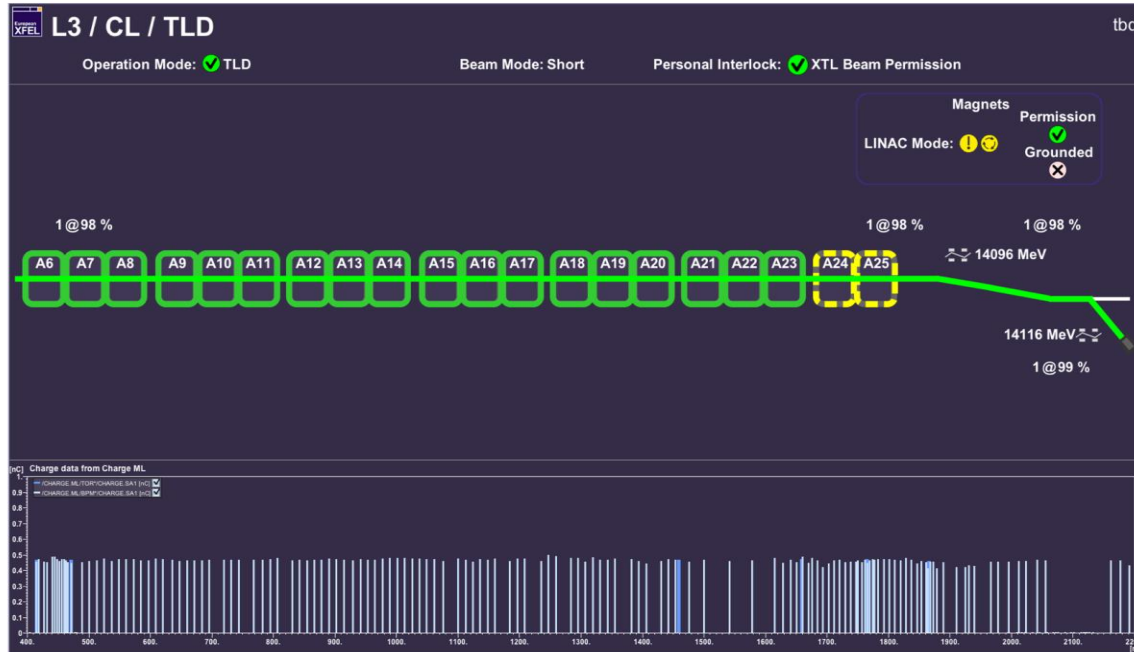
# European XFEL: Module performance

14 GeV achieved (22 June 2017 00:30)



- Some performance reduction observed wrt to vertical test.
- Waveguide investigation ongoing.
- Operation of RF stations “off beam” allows single RF stations to be investigated in parallel to lasing.
- Average Q-value  $> 10^{10}$ !

# European XFEL: L3 operation



in operation



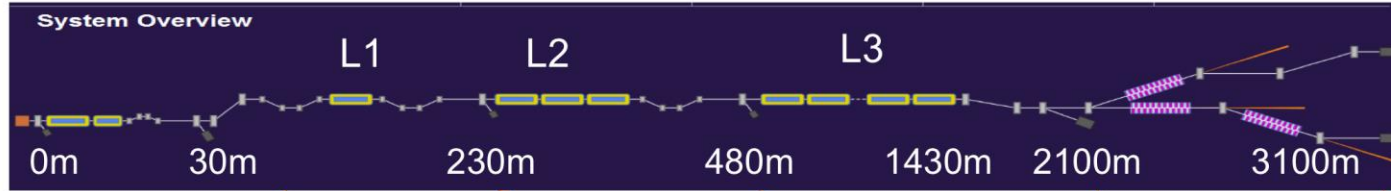
ditto. but shifted  
off beam



off

- All RF stations including CS8 are commissioned at moderate gradients.
- Operation automatized and handed over by experts; energy goal for 2017/2018 reached.
- Detailed measurements will show the path towards higher beam energies.
- The last two stations (CS9) require still longer tunnel access.

# European XFEL: Commissioning progress



13/01\*  
\* Beam permission on 13/01

15/01 @ 130 MeV  
19/01 @ 600 MeV

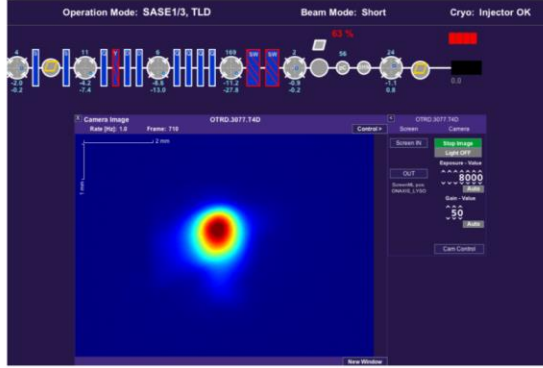
02/02 @ 600 MeV  
22/02 @ 2.5 GeV

25/02 @ 2.5 GeV  
19/03 @ 6 GeV  
08/04 @ 12 GeV

27/04\*

\* Beam permission on 26/04

27/04 Beam spot before dump

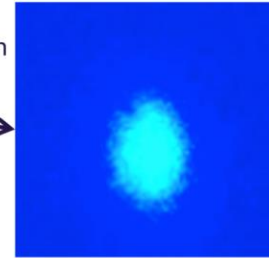


keen on lasing...

# European XFEL: Commissioning progress

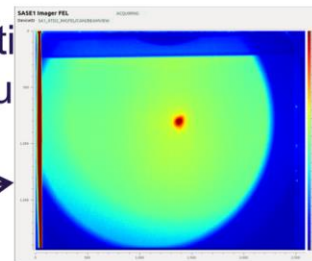
- First lasing (0.9 nm) reached on May 2nd/3rd.
- Commissioning of the photon beam diagnostics and transport was next.
- Beam based alignment in the SASA1 undulator section followed. And gave good results.
- First laser light at 2 Å on May 24th.
- On May 27th we reached an energy of up to 1 mJ i.e. close to saturation.

■ SASE spot on YAG screen



- Safety authorities handed out the operational permission for the SASE1 hutches on June 21st.
- On June 23rd we lased at 1.5 Å.

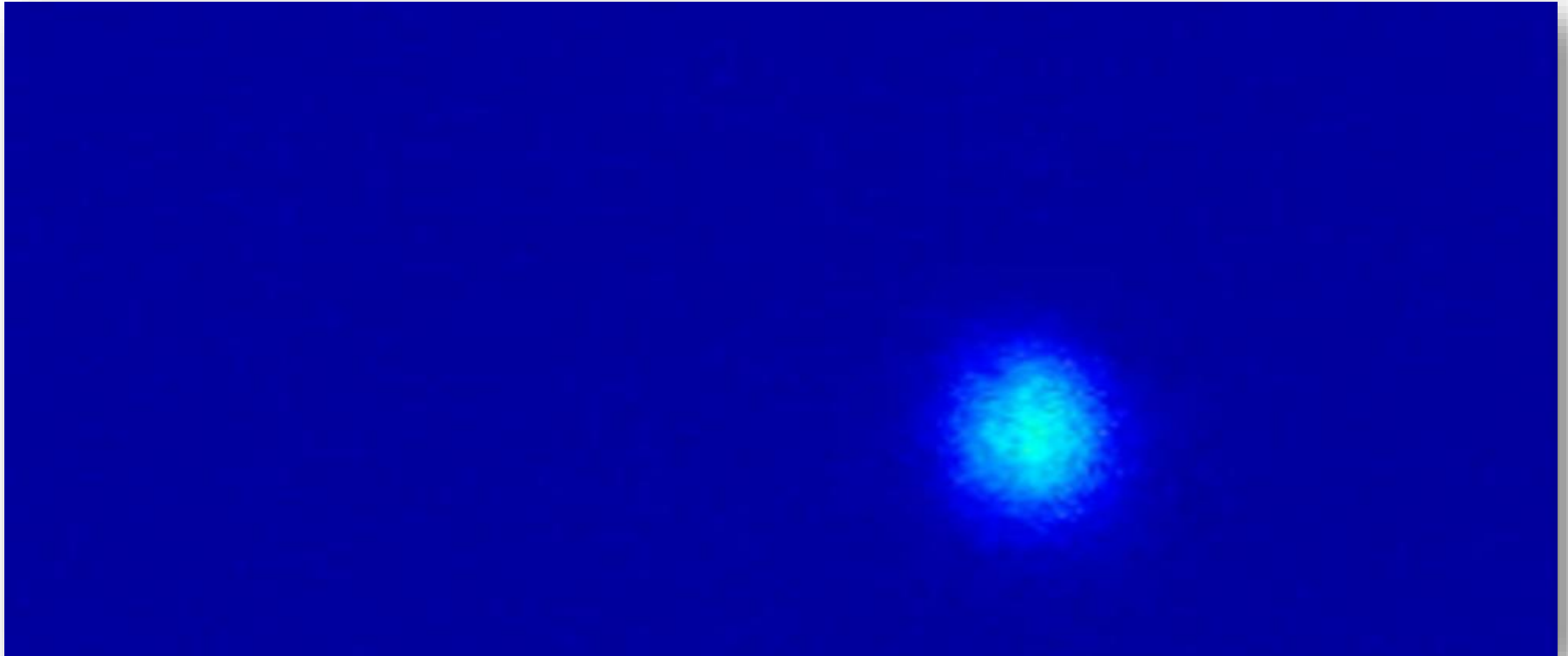
■ GMD intensity signal (calibrated)



■ SASE spot on FEL imager



# First laser light on 3 May

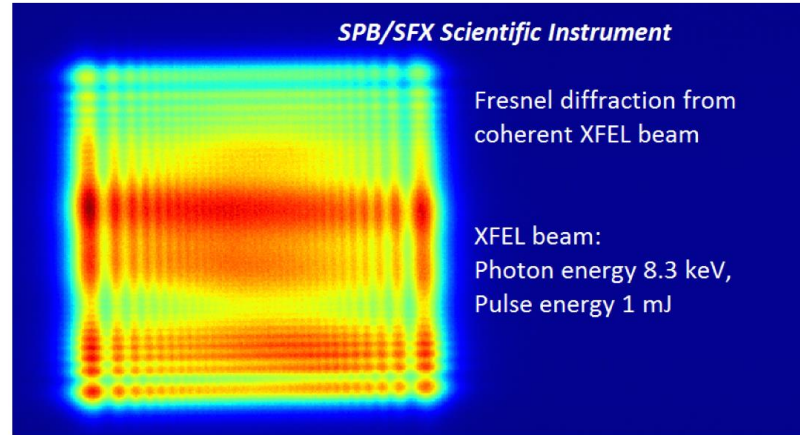


# First light to the FXE and SPB instruments: June 23rd

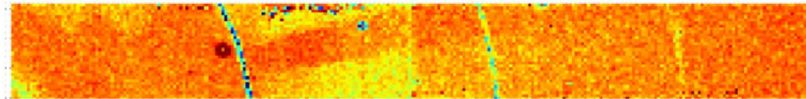
The screenshot displays the ILC control interface, divided into several main sections:

- BEAMVIEW (FXE\_XTD9\_IMGPI/CAM/BEAMVIEW):** Shows a 2D beam profile with a central spot. The status is "STOPPED" and the frame rate is 0.0. A warning at the bottom reads: "Warning: After image storage, uncheck write flag!".
- SPB Pop-in XTD9 (SPB\_XTD9\_IMGPI/MAIN):** Shows a similar 2D beam profile. The status is "STOPPED". A warning at the bottom reads: "Warning: After image storage, uncheck write flag!".
- SASE1 M3 MAIN (SASE1\_M3\_MAIN):** Contains a schematic diagram of the SASE1 M3 instrument and two control panels.
  - SASE1 M3 RY (pitch):** Shows the pitch control for the mirror. The status is "STOPPED". The position is -2.516 mm. The Hi limit is 20 mm and the Lo limit is -20 mm. The TargetPos is -2.516 mm.
  - SASE1 M3 TX:** Shows the TX control for the mirror. The status is "STOPPED". The position is -11.0684 mm. The Hi limit is 20 mm and the Lo limit is -20 mm. The TargetPos is -11.0684 mm.
- XTD9 Beam Line:** A schematic diagram of the XTD9 beam line showing various components: Beam loss monitor, M3, Pop-in monitor, Beam loss monitor, XGM, Pulse Picker, Attenuator, Screen, CRL2, Pop-in monitor, Shutter SPB, and FXE. The status of each component is indicated by a green light.

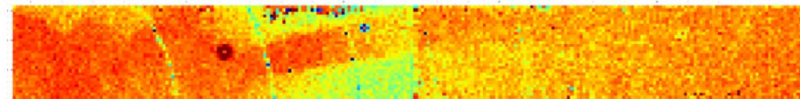
# European XFEL: First FXE data



■ Slit scattering SPB, slit 1x1 mm<sup>2</sup>



■ Single shot Si and LaB6 powder diagram FXE



# European XFEL: User operation

- 1st Call for proposals (SASE1) 1 / 2017
- 63 proposals received March 20 / 2017
- First lasing in SASE1 May 2 / 2017
- First beam in hutches June 23 / 2017
- Commissioning SASE1 and instruments 5 – 9 / 2017
  
- Start of users operation FXE, SPB/SFX Sept. 14 / 2017  
(7 weeks in 2017)
- 2nd call for proposals (SASE1) Late Summer 2017
  
- Lasing SASE3 Late Summer 2017
- Lasing SASE2 End 2017
- Start users operation SASE2 and SASE3 Mid 2018

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- The European strategy process
- XFEL status
- **SCRF at DESY and in Europe (thanks to M. Wenskat)**
- ILC European Action Plan
- NDA with DESY

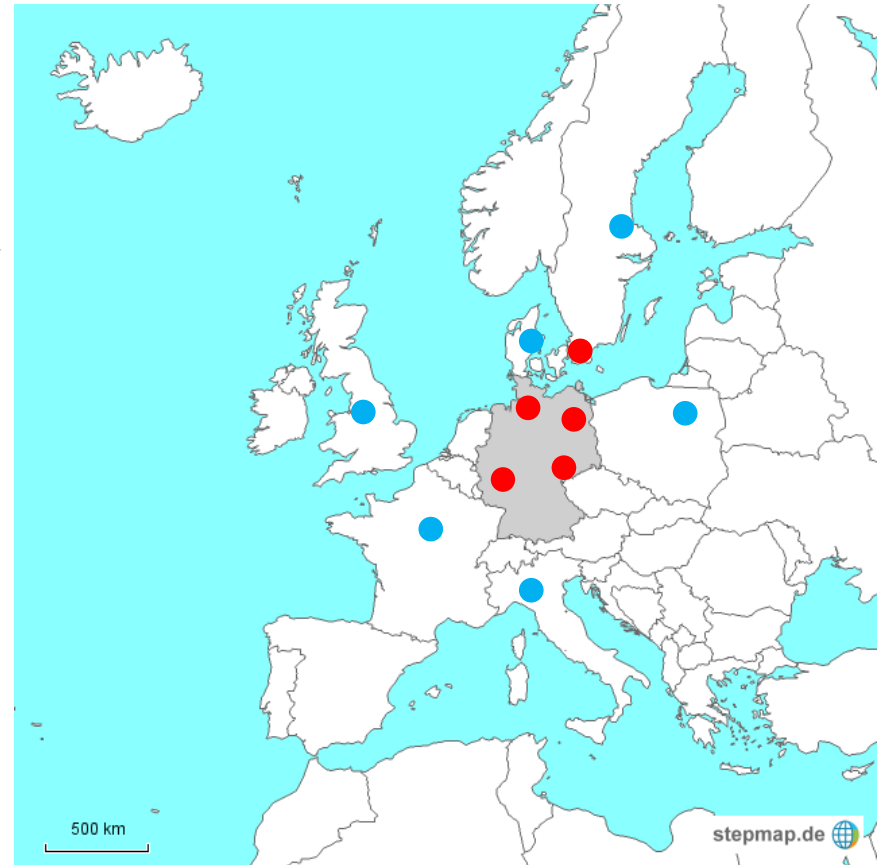
# SCRF developments in Europe

## ■ Projects

- European XFEL (DESY, +800 cavities)
- European Spallation Source (146)
- ELBE / HZDR (SRF gun R&D)
- BERLinPro (HZB): SRF ERL for accelerator R&D (gun, beam dynamics)
- SCRF accelerators at universities (Darmstadt, Mainz, Bonn, ...)

## ■ Partners

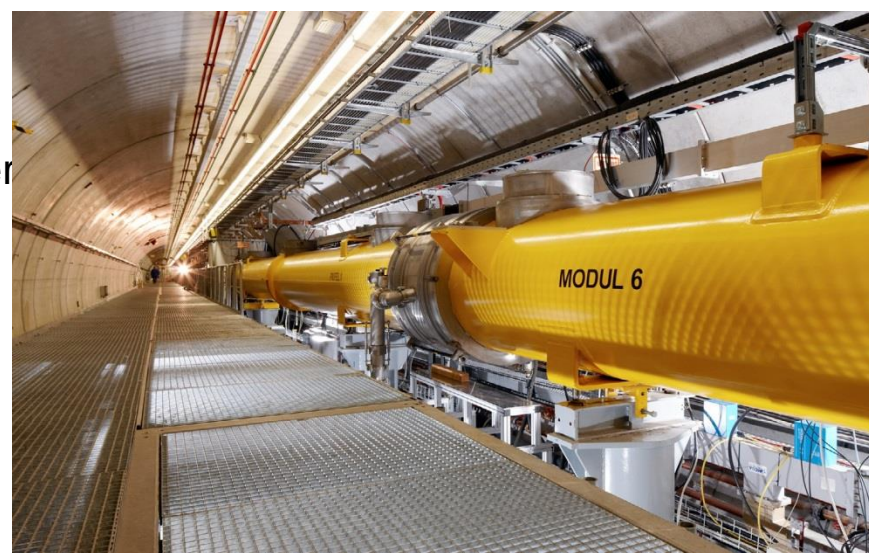
- CEA Saclay, LAL Orsay, IRFU
- Uppsala U, Aarhus U
- INFN Milano
- STFC Daresbury
- Wroclaw U, IFJ
- +50 other





# SCRF developments at DESY

- Only cavity R&D mentioned – no LLRF, coupler
- Project-based
  - SRF gun
    - Two guns produced (last week)
    - XFEL upgrade for cw (long-term)
  - FLASH upgrade
    - Two modules exchanged
    - One module: ILCHiGrade cavities
- Fundamental R&D
  - Infusion / doping: Nitrogen baking to reduce losses; cavity R&D - process parameter studies; sample R&D - material studies
  - Large-grain studies: lower losses? Statistical analysis of cavity data, material studies



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# The ILC European Action Plan – Reminder

- Originally requested by Okada-san from the KEK ILC Planning Office
  - A report outlining Europe's possible contribution during four-year preparatory phase
  - Similar to KEK document
  - Discussed by Okada-san and E. Elsen
  - Suggestion to prepare this within E-JADE context, with Steinar S. as coordinator
- Comparison to KEK document
  - KEK document deals with only one country (in fact only one lab)
  - Europe is much more complicated: many countries, labs, funding agencies
  - Scope therefore shifted to potential EU in-kind contributions (cost of EU IKC, EU core competencies, who might do what ...) along ILC WBS
- Since about half a year: preparation of document by small team of editors.

# The ILC European Action Plan – Status

- Currently two documents prepared:
  - A long and detailed one, containing numbers (i.e. costs of potential European in-kind contributions).
  - A short one without the details (in order not to give the impression of a commitment).
- The long one was presented to CERN management in July.
  - Positive overall reaction
  - CERN asked for the short document to be prepared as input to CERN Council.
  - It is discussed in Council today.
- Document to be handed over to KEK management soon (latest at the timescales of LCWS in Strasbourg).
- Hope: together with ICFA statement, the EAP might give some more positive momentum to a political decision in Japan.

# Topics

- The European strategy process
- XFEL status
- SCRF at DESY and in Europe
- ILC European Action Plan
- **NDA with DESY**

# Non-Disclosure Agreement KEK - DESY

- NDA between KEK and DESY signed in August 2017
- *“This Non-Disclosure Agreement (the “Agreement”) is hereby made and entered into by and between The High Energy Accelerator Research Organization (“KEK”) and Deutsches Elektronen-Synchrotron (“DESY”) with respect to the handling of Confidential Information for the ILC project (the “Project”) between KEK and DESY (the “Purpose”) disclosed mutually by and between the Parties hereto.”*
- Mainly regulates, with much legal phraseology, the question what is confidential information, and how to manage it.
- We agreed on having one contact person each at DESY and KEK to manage the list of DESY and KEK staff eligible to have access to confidential information.
  - At KEK: Hitoshi Hayano
  - At DESY: Thomas Schörner
- Current list of proposed DESY names on next slide



# Non-Disclosure Agreement KEK - DESY

- Ties Behnke
- Karsten Büsler
- Benno List
- Uwe Schneekloth
- Thomas Schörner
- Klaus Sinram
- Marcel Stanitzki

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