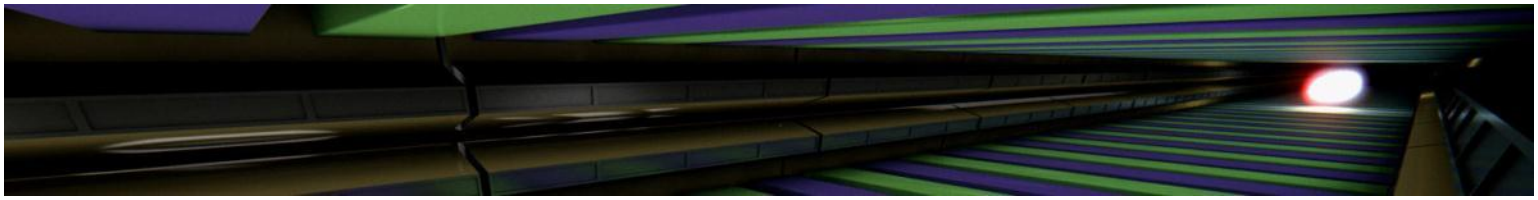


Status of the European XFEL Accelerator Construction Project

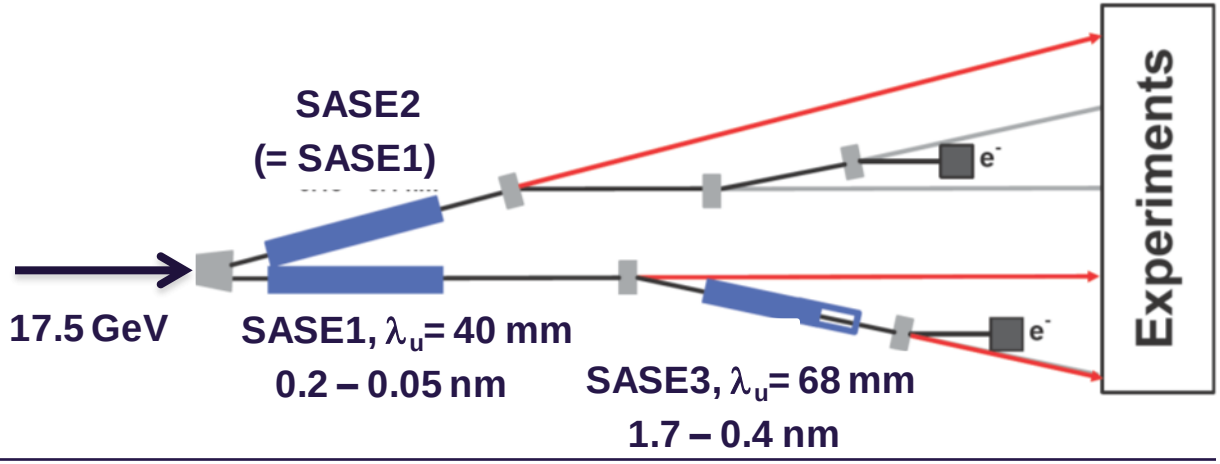
Reinhard Brinkmann, DESY

European XFEL Introduction

Some specifications

- Photon energy 0.3-24 keV
- Pulse duration ~ 10-100 fs
- Pulse energy few mJ
- Superconducting linac. 17.5 GeV
- 10 Hz (27 000 b/s)
- 5 beamlines / 10 instruments
  - Start version with 3 beamlines and 6 instruments
- Several extensions possible:
  - More undulators
  - More instruments
  - …….
  - Variable polarization
  - Self-Seeding
  - CW operation

First beam for users 2016



Organization of the European XFEL Project

In-kind Contributions

Accelerator Consortium

Coordinator:

H. Weise, DESY

Institutes from D, F, I, CH, PL, ES, RU, CN, SE…

Other In-kind Contributors

European XFEL GmbH

Council

Chair R. Feidenhans'l

Management Board

Managing Directors

M. Altarelli, Chair

C. Burger, Admin. Director

Scientific Directors

S. Molodtsov

A. Schwarz

T. Tschentscher

Advisory Committees

SAC

MAC

AFC

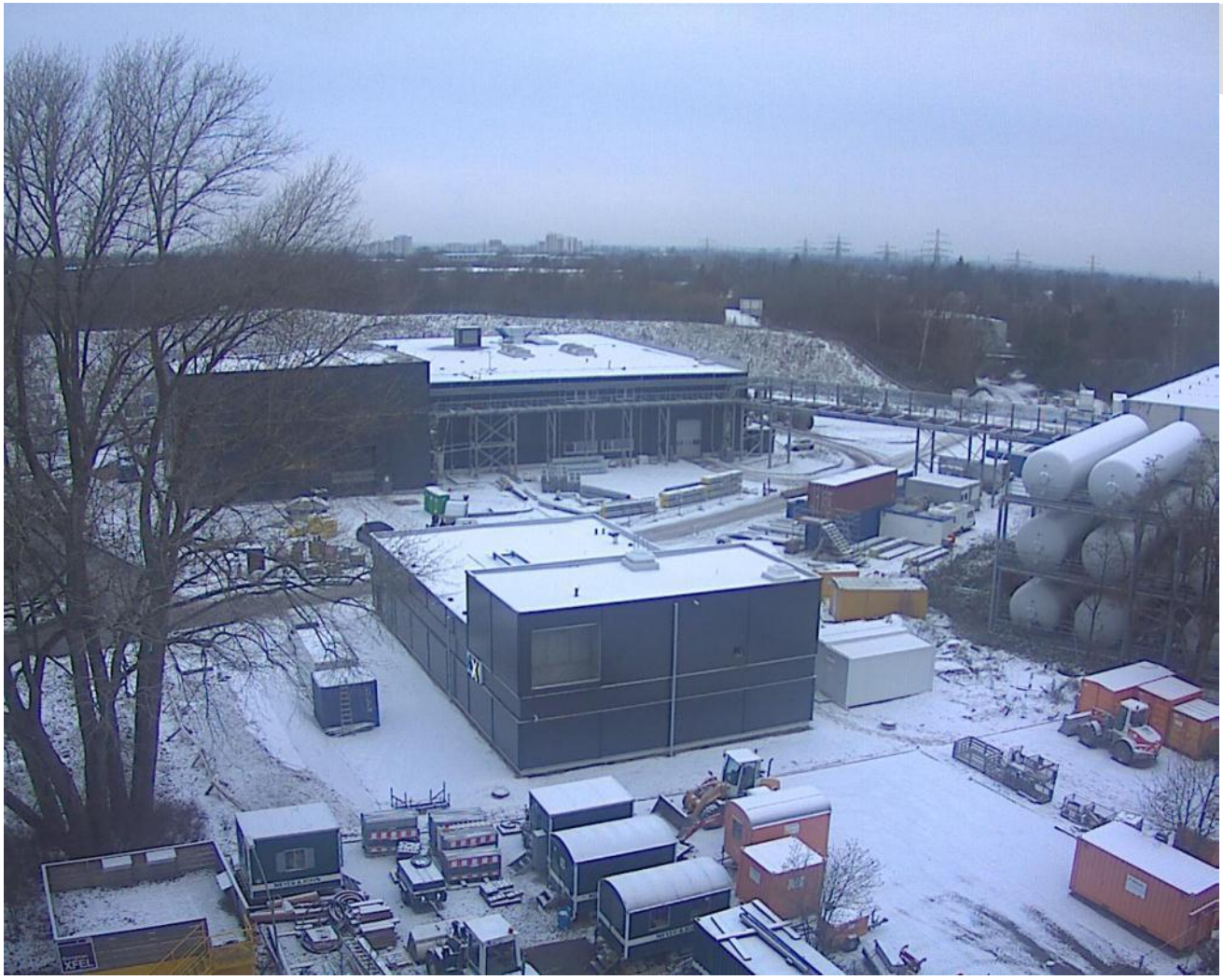
IKRC +

Det. AC

Lasers AC

European XFEL

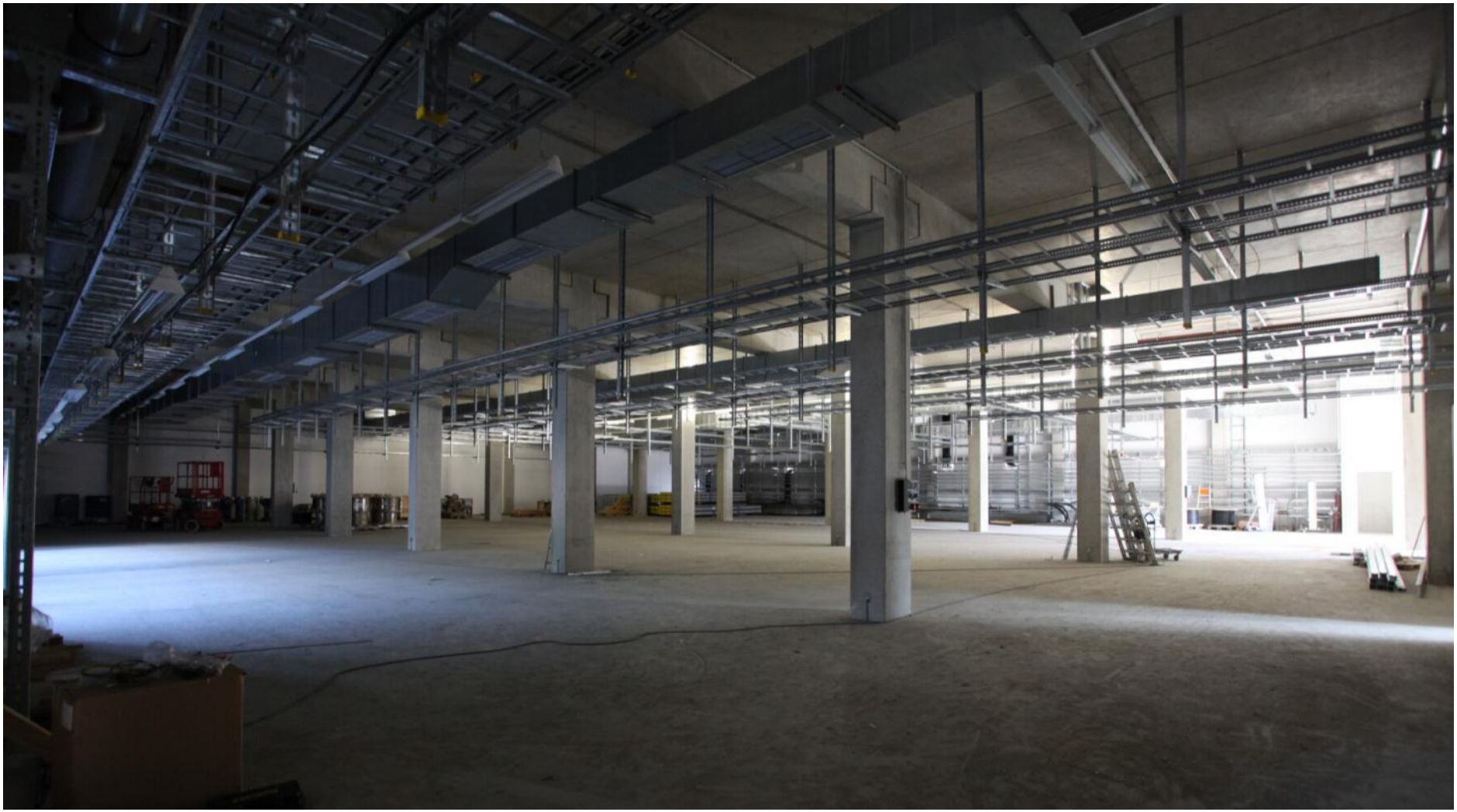
Civil Engineering Progress



18 January 2013

European XFEL

Modulator hall – modulators beginning to come



European XFEL

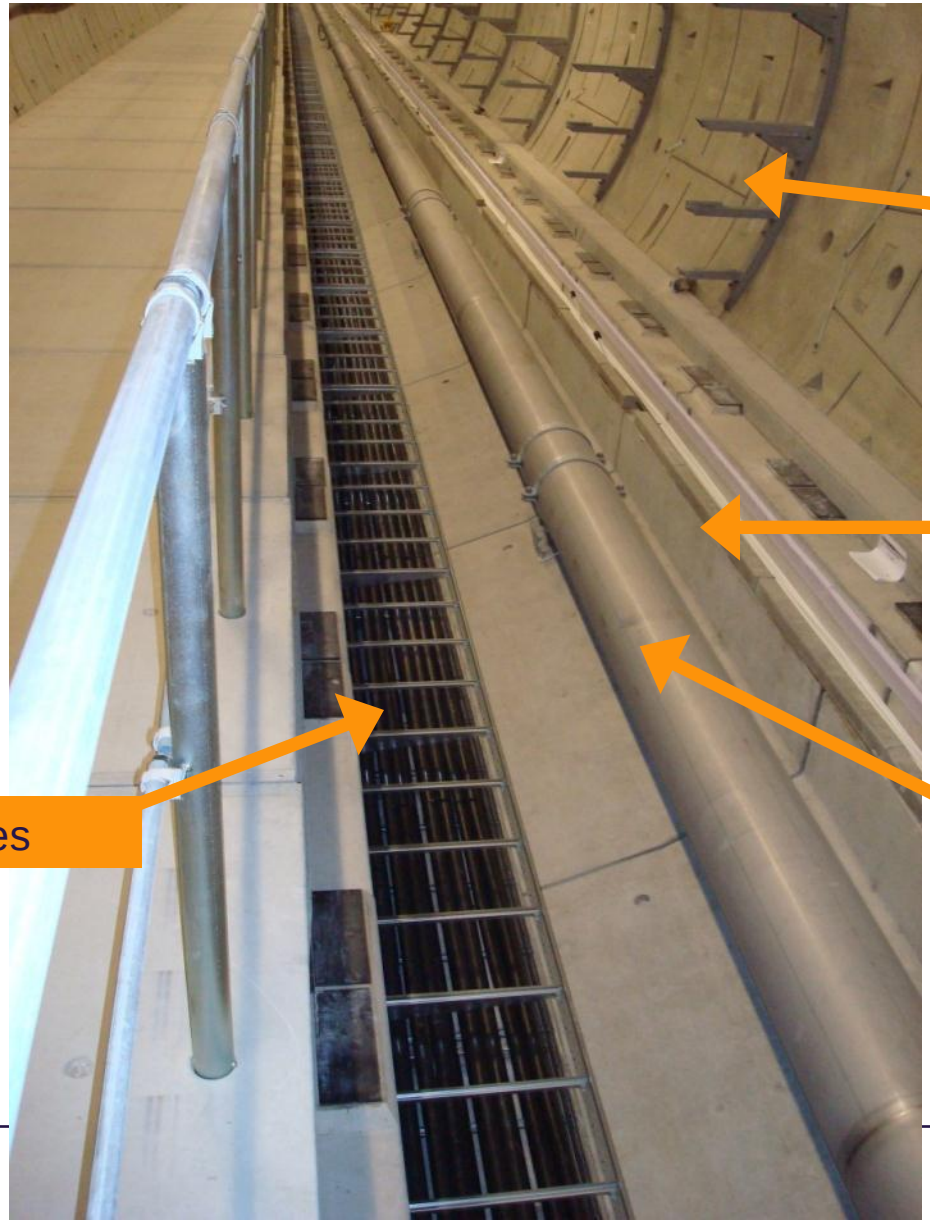
Injector shaft

European XFEL

Prototype Linac girder installed in tunnel

Tunnel infrastructure installation

- Started March 2012
- Well on schedule, completion Sept 2013



European XFEL

Schenefeld campus

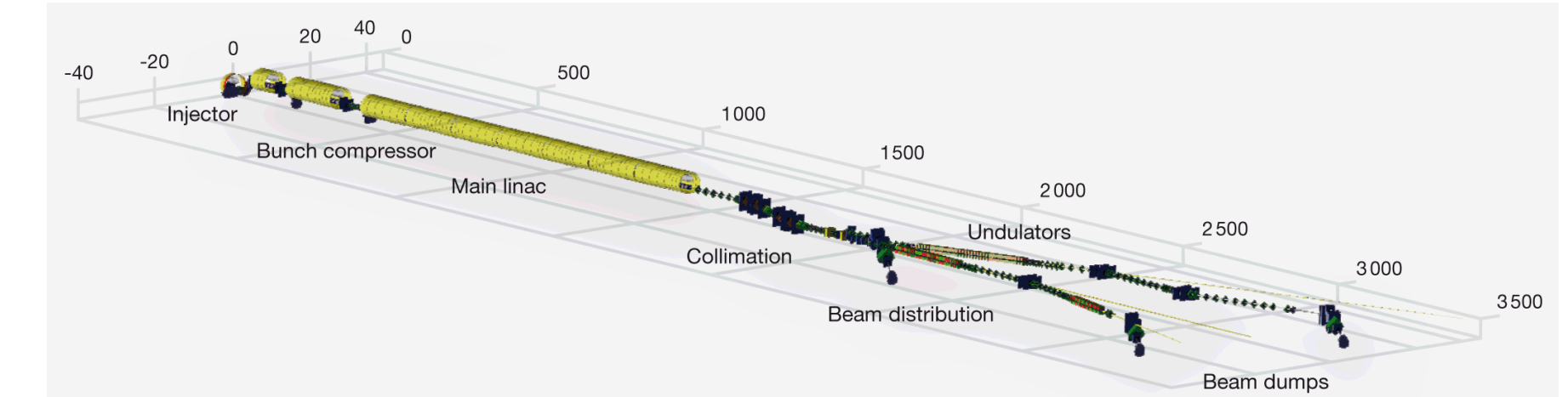
European XFEL

Experimental hall – essentially completed

Architect's concepts for the XHQ building

European XFEL

Accelerator Consortium



energie atomique • energies alternatives

Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Les deux infinis

HELMHOLTZ ASSOCIATION

Istituto Nazionale di Fisica Nucleare

UNIVERSITÀ DEGLI STUDI DI MILANO

POLITÉCNICA

PAUL SCHERRER INSTITUT

Stockholm University

UPPSALA UNIVERSITET

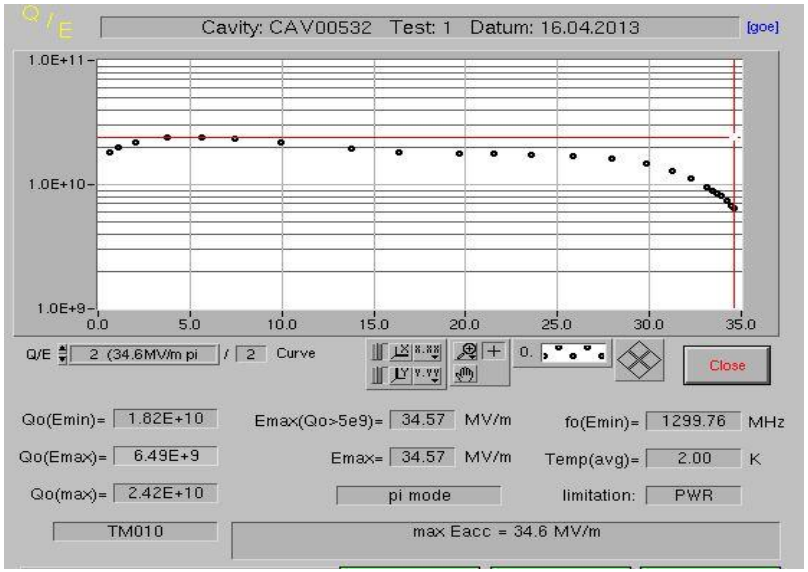
Wrocław University of Technology

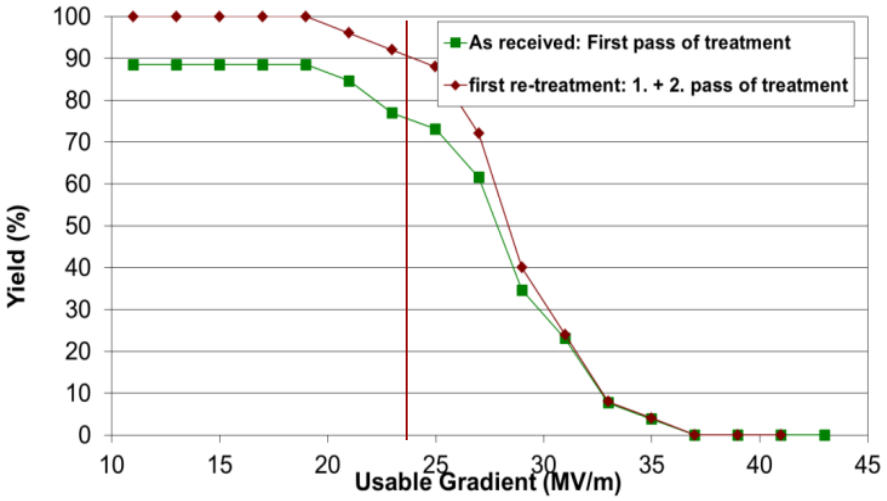
European XFEL

Test facility AMTF in operation

Successful start of cavity production

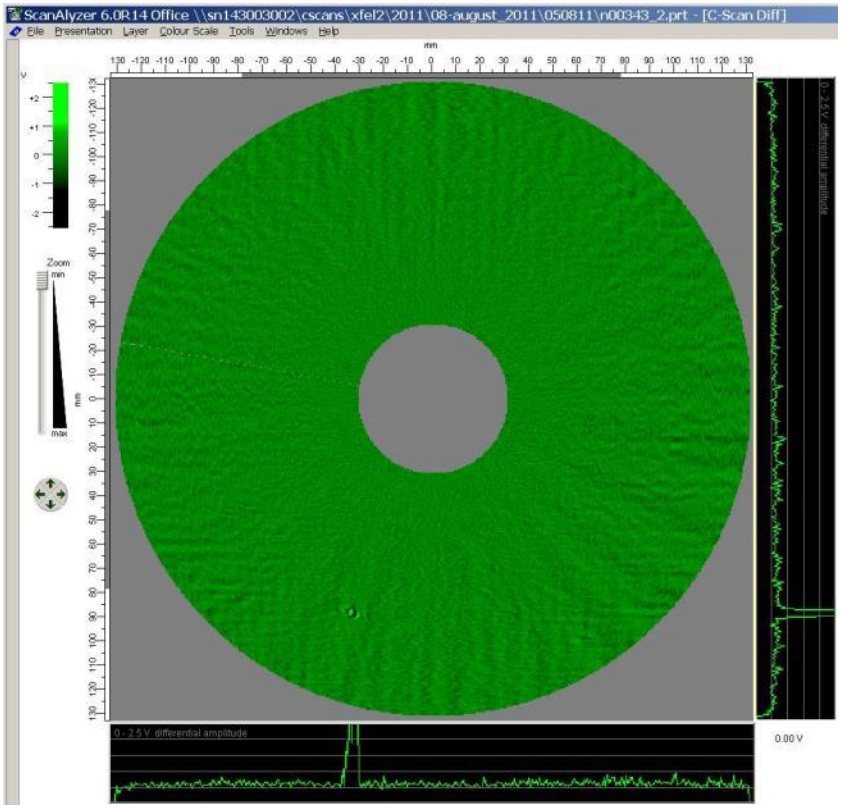
- Cavity production (DESY – INFN/Milano) and test stand operation (DESY – Wroclaw Univ. – IFJ-PAN Kracow) started few months late, but remarkably smooth
- By now >30 cavities (Zanon is ahead of RI…), increasing every week
  - Average gradient **27.9MV/m** well above XFEL spec 24 MV/m
  - 3 cavities with field emission rinsed at DESY with ultrapure water → good performance afterwards
- 1st batch of 8 cavities was delayed 2 months (for 1st pre-series module assembly), but by now have comforting buffer of cavities

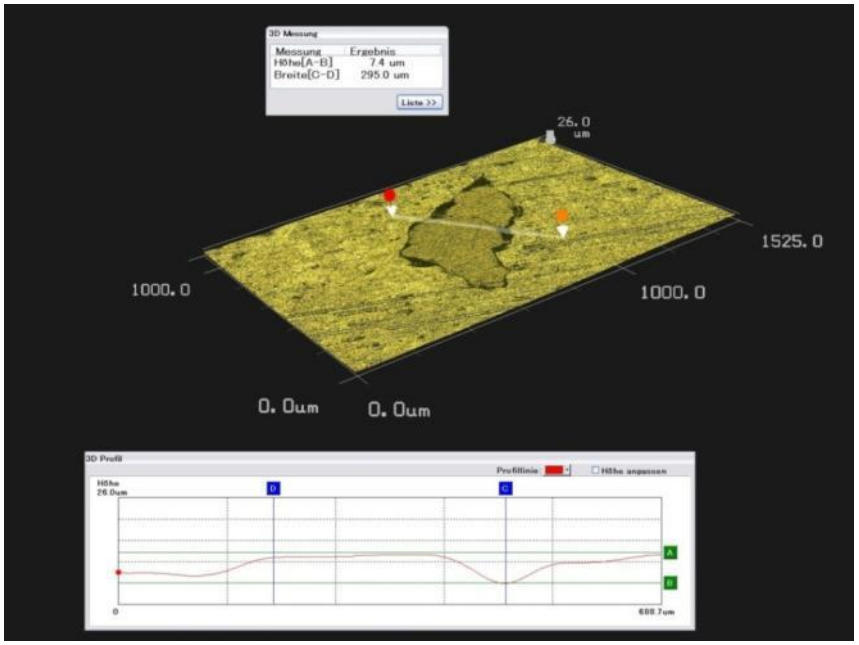


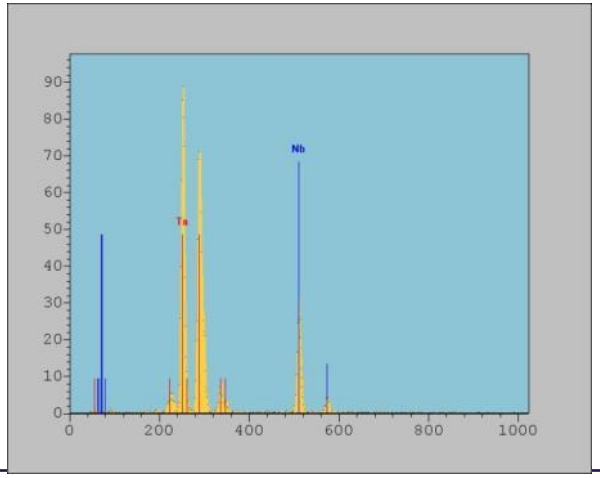


European XFEL

Nb material qualification at DESY





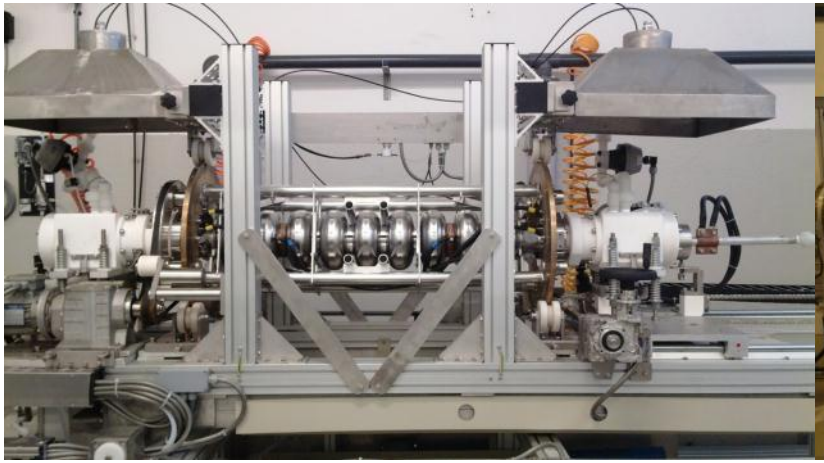


Example for Ta detection

- eddy current scan
- 3D -microscope image
- nondestructive element analysis

European XFEL

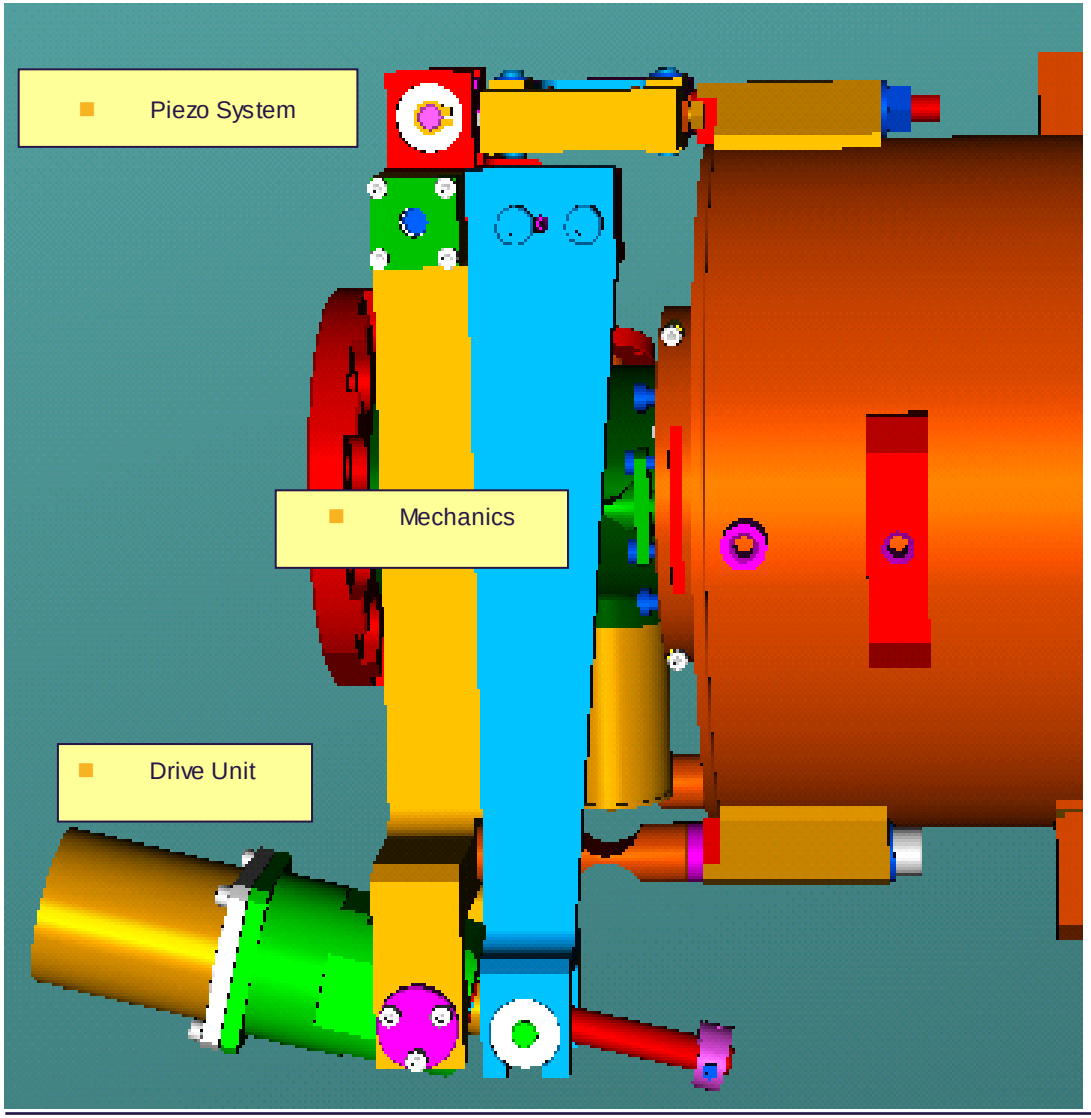
Impressions from cavity manufacturing…



Cryostats/vessels

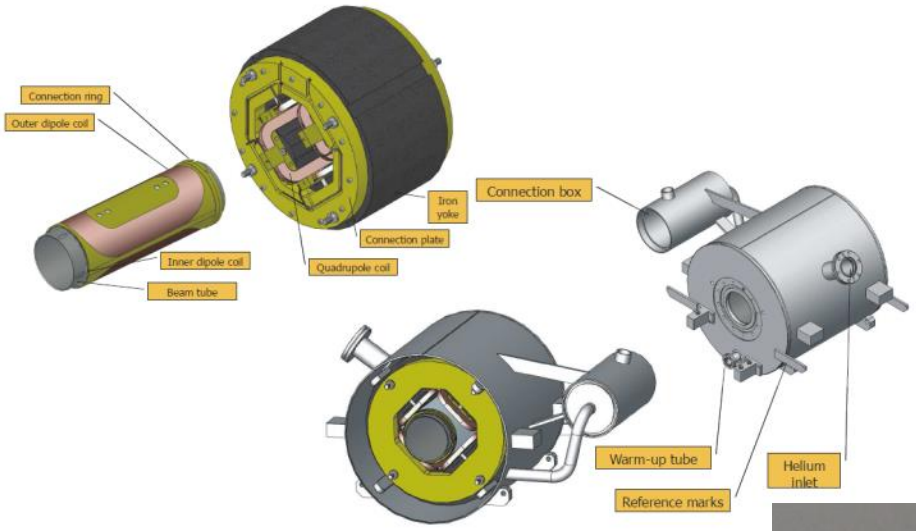
- a total of 13 cryostats & cold masses delivered by E. Zanon
- 8 units delivered by IHEP/Beijing (not an IKC) but 7 need re-work due to non-conformities
- next 4 IHEP cryostats & cold masses arrive in 5/2013; expected to be ok
- overall delivery schedule ok

Frequency tuners

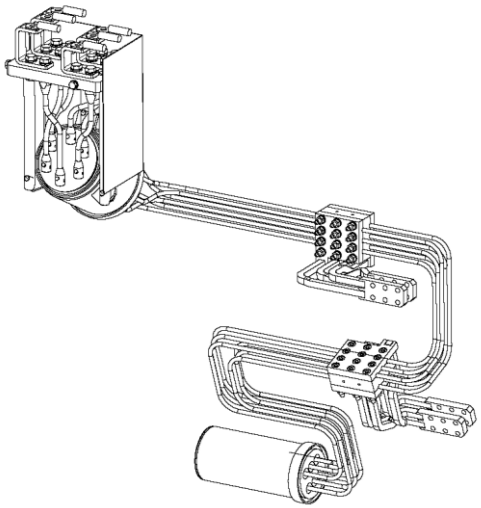


- **Mechanics:**
  - Series fabrication ongoing.
- **Drive unit:**
  - Documentation reports decided.
  - First units have FAT and been delivered to CEA and DESY.
  - Ramp up to series rate has been achieved.
- **Piezo system:**
  - Continuing tests of permanent FLASH setup.
  - Series production of fixtures ongoing.
- **QC testing:**
  - during module installation at Saclay (INFN contribution).

Sc quads and current leads



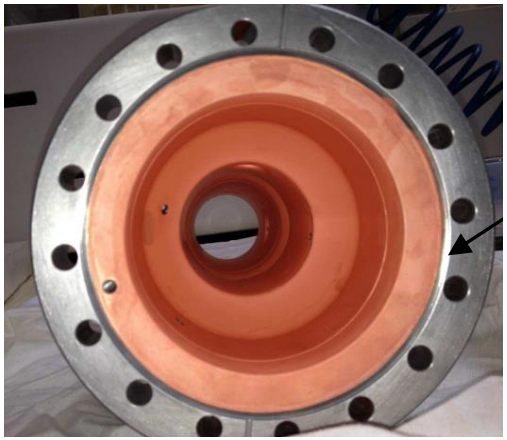
- **25 magnets** (CIEMAT IKC) measured at DESY (IFJ-PAN IKC)
- **current leads** (DESY IKC) for first modules available

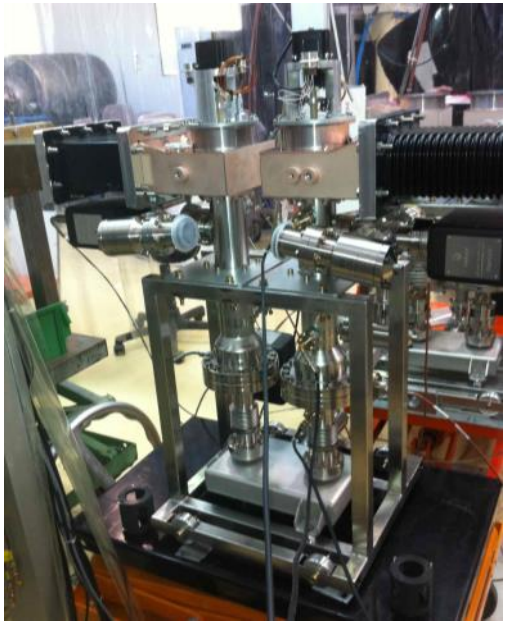


- **assembly of quad packages** stopped after 8 units due to buffer overflow

RF power couplers – critical schedule!

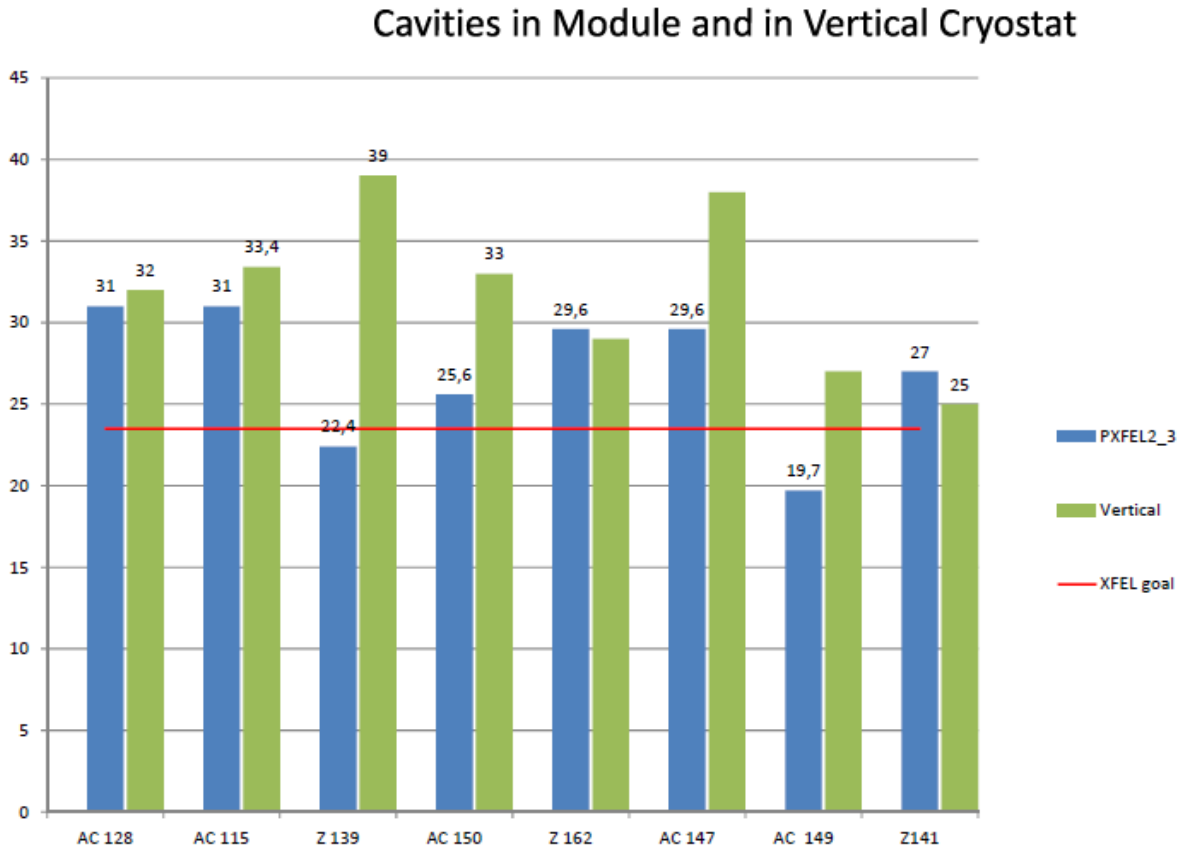
- French contribution, manufacturing in industry, test/processing at LAL/Orsay
- copper coating in industrial production took long time to reliably establish
- by now two couplers /week delivered, ramp-up to 4/week soon, ramp up to required rate 8/week with additional infrastructure & shifts
- most critical component to avoid further delays in the ramp-up of accelerator module assembly at CEA/Saclay





Module assembly (DESY – CEA/Saclay)

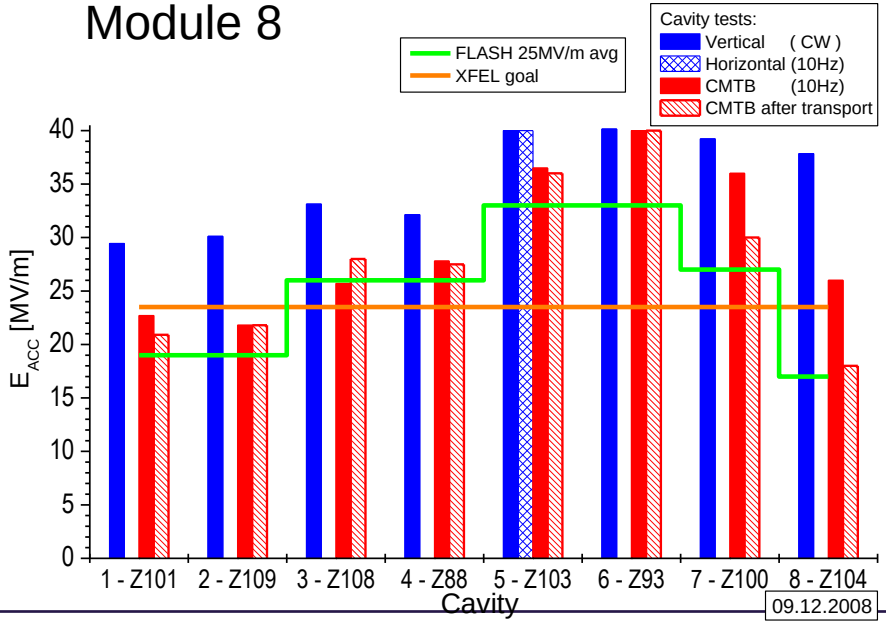
- Performance drop after assembly not yet avoided…
- *(but this prototype module still performs above XFEL spec)*



Module transport test Hamburg-Saclay-Hamburg 2008…

- Vibration/shock-damped transport frame developed in industry
- After truck transport to Saclay, back on CMTB at DESY for RF test:
  - No mechanical damage, no vacuum leaks
  - Cool-down and RF-powering without problems
  - two of 8 cavities show reduced gradient (36→30, 26→18 MV/m)
  - Possible reason (speculative): small dust particles shaken loose and changed position ??

Module 8



RF system components

- all major components ordered
- several components delivered, e.g.
  - 4 klystrons
  - 8 modulators
  - 12 pulse transformers
  - 18 connection modules
  - 100% pulse cables delivered and 80% installed
  - 22 preamplifiers

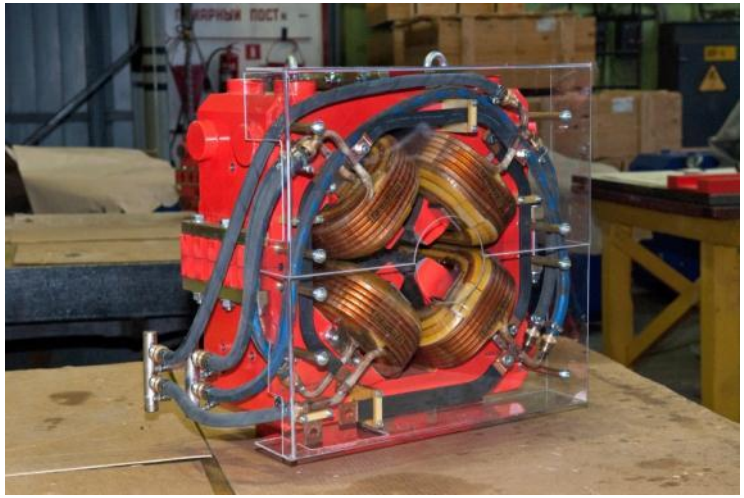
- RF interlock in production
- CFT for PS for RF racks done
- Installation procedures to be finalized

Warm magnet production

- PRR for 19 out of 23 magnet types are finished; covers 95% of the more than 700 magnets
- magnet fabrication is in full swing

XBB

XSC

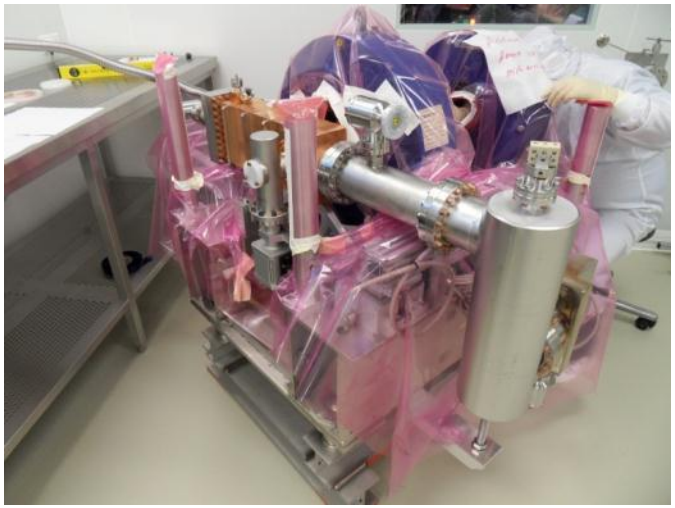


XQE

- quality control / magnetic measurement started at DESY
  - XBB: 11 out of 14 magnets delivered
  - XSC: All 17 magnets delivered
  - XQE: 14 out of 43 magnets delivered

Warm vacuum components

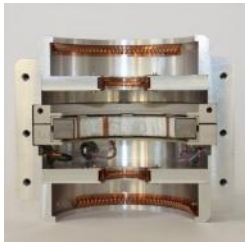
- RF gun clean room assembly and shipping to DESY, Zeuthen (conditioning)
- BC chicane 2nd prototype at BINP
- Main collimator prototype at BINP

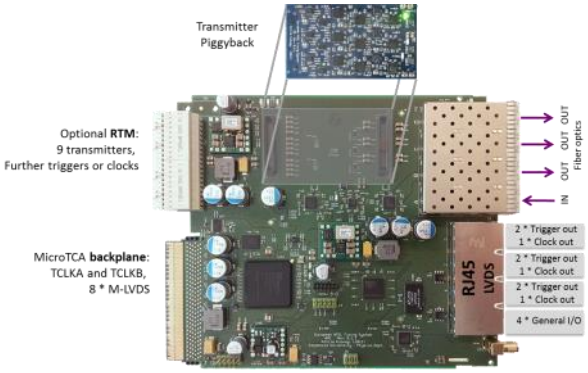


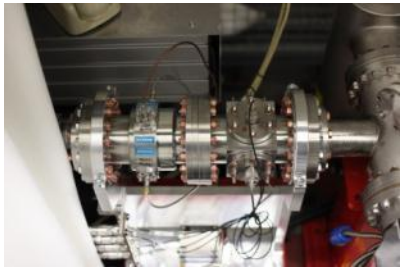
- beam line reviews passed for injector, BC1 straight and main dump sections

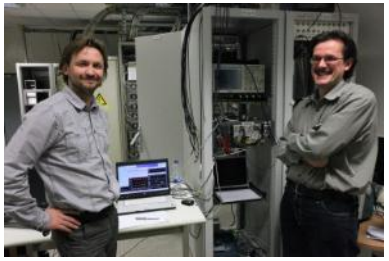
European XFEL

Beam diagnostics, timing, LLRF, …









Schedule, cost

- Module assembly delayed due to delayed delivery of components
  - This is the project's critical path
  - From present point of view, 6 – 9 months delay for completion of project → 1st SASE beam autumn 2016
  - Will try to catch up by accelerating assembly (extra shifts) if possible (under discussion with CEA) – *RF coupler delivery rate must be reached!*
- Accelerator complex cost (~520M€ y2005 incl. tech infrastructure) approximately 6% above original plan
  - Most cost figures by now well known, residual uncertainty, incl. delays, few percent

Thank you for your attention!