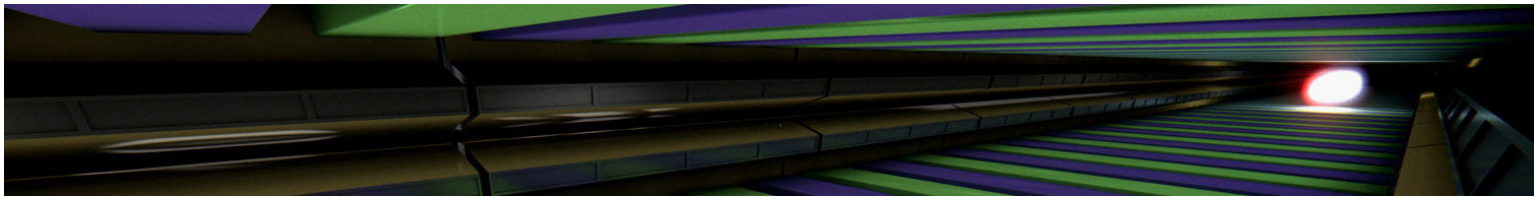
European XFEL



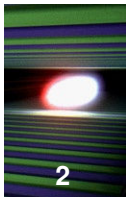
XFEL
an introduction

Hans Weise / DESY

DESY

HELMHOLTZ ASSOCIATION

Organization of the European XFEL GmbH



XFEL Council

Accelerator Consortium
Coordinator: DESY

Institutes from F, I, PL, RU, E, etc.

Other In-kind Contributors…

European XFEL GmbH

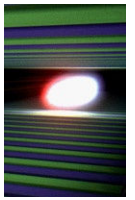
Management Board

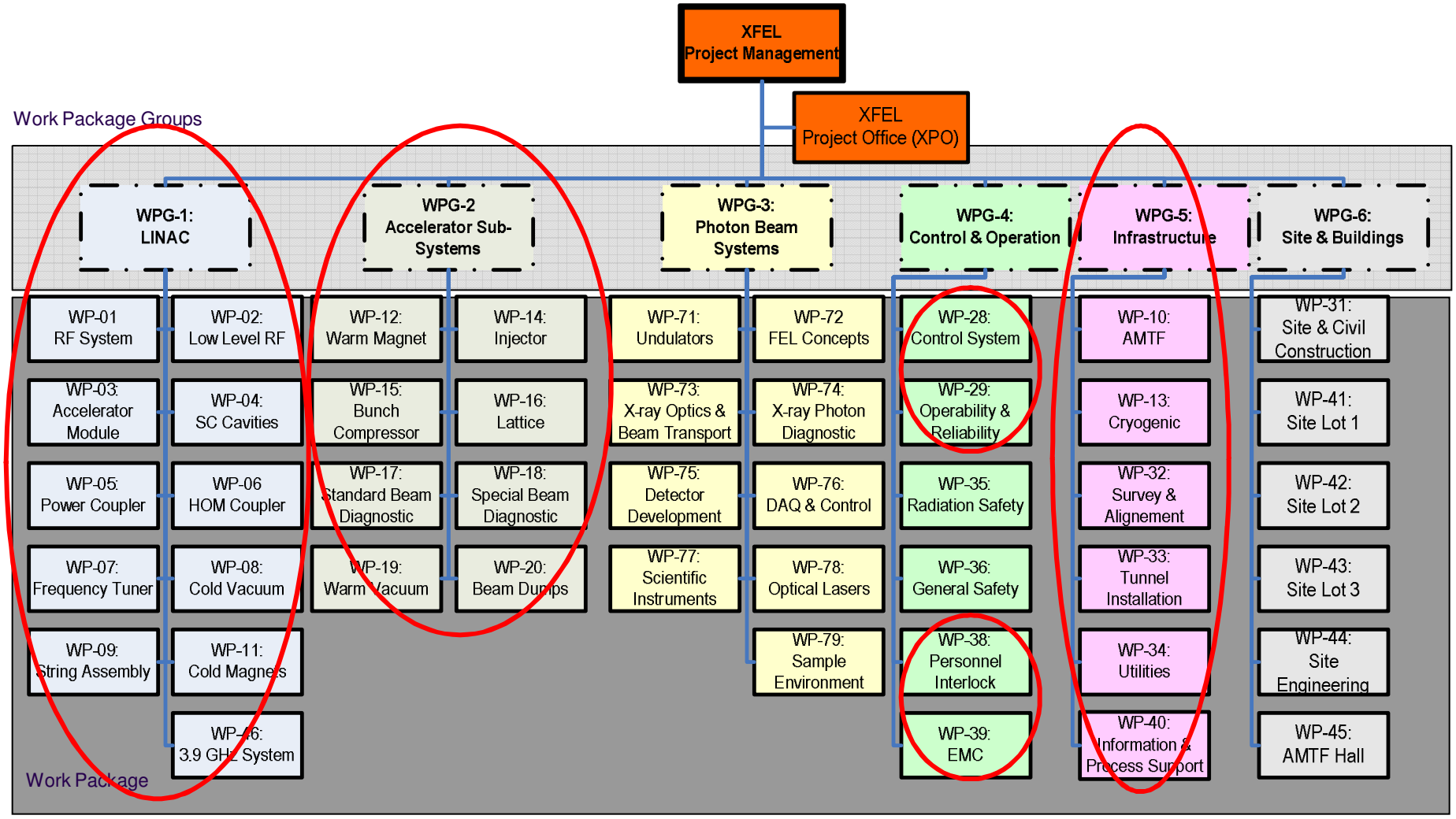
2 Managing Directors:
Chairman, Admin. Director

3 Science/Technical Directors

European XFEL

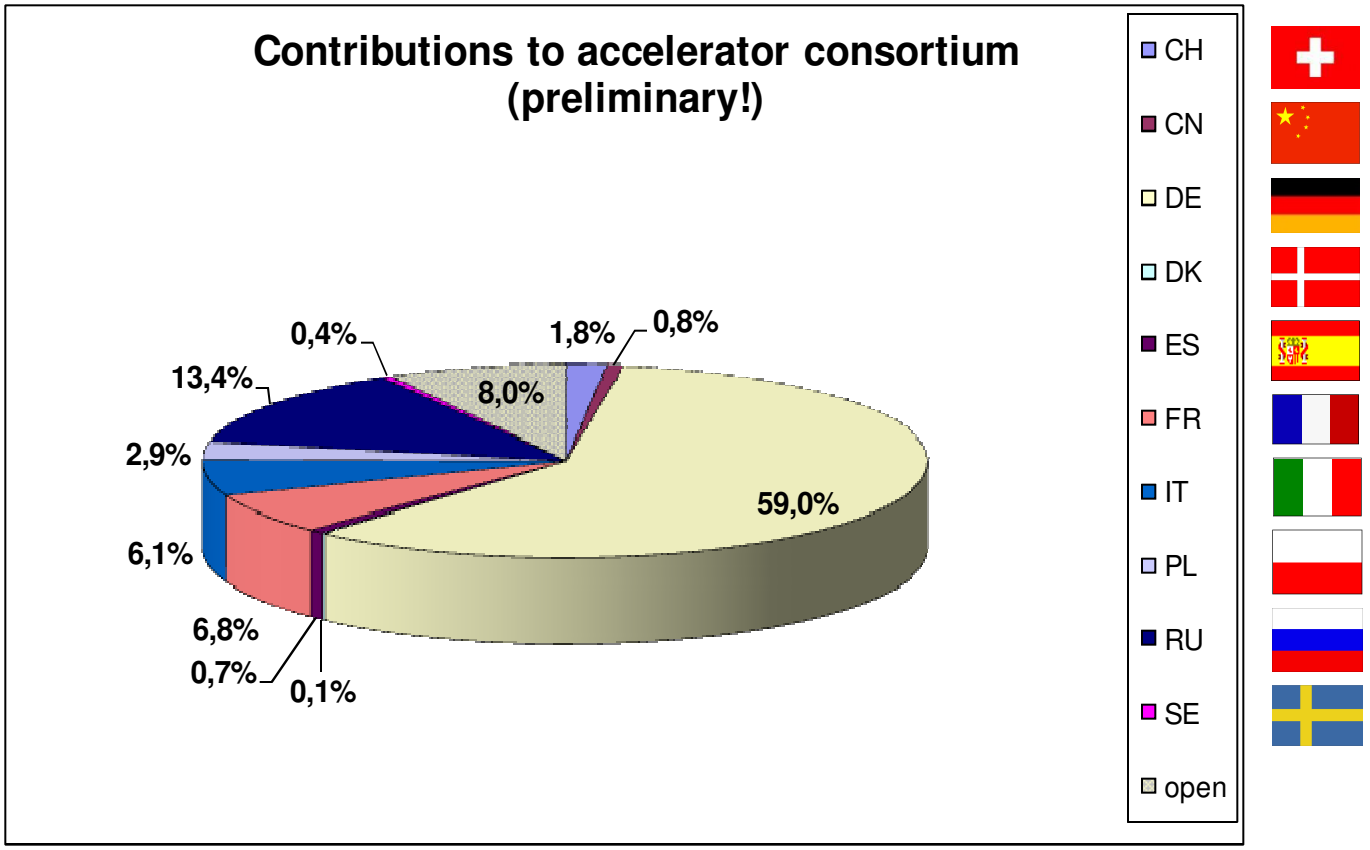
Accelerator Consortium Work Packages





Accelerator In-kind Contributions (total value ~500 M€)

Figures will change in detail – negotiations ongoing!



Many institutes from TESLA collaboration & some new partners

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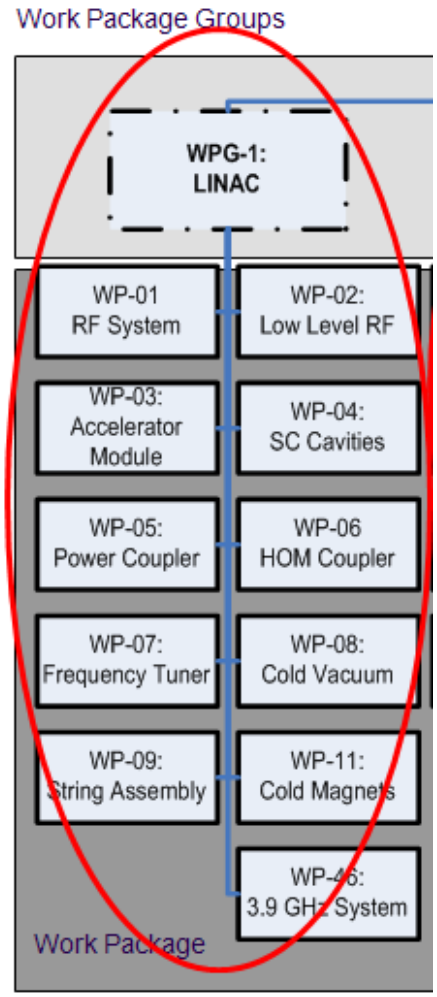
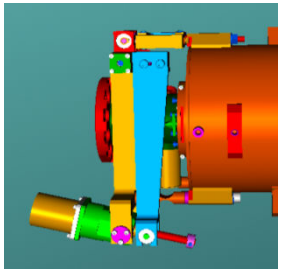
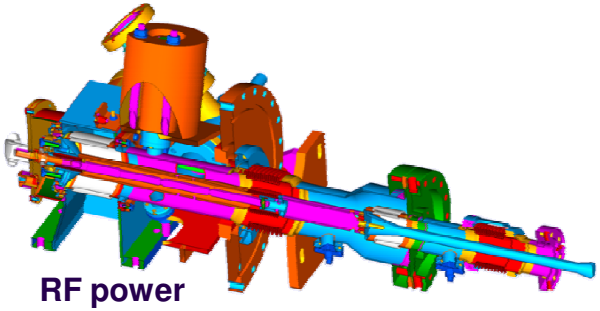
The Cold Linac



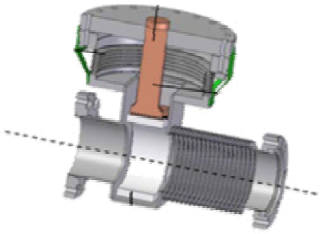
- s.c. accelerating cavities
- RF power coupler
- frequency tuners
- vacuum components
- cold magnets



frequency tuner



RF power coupler

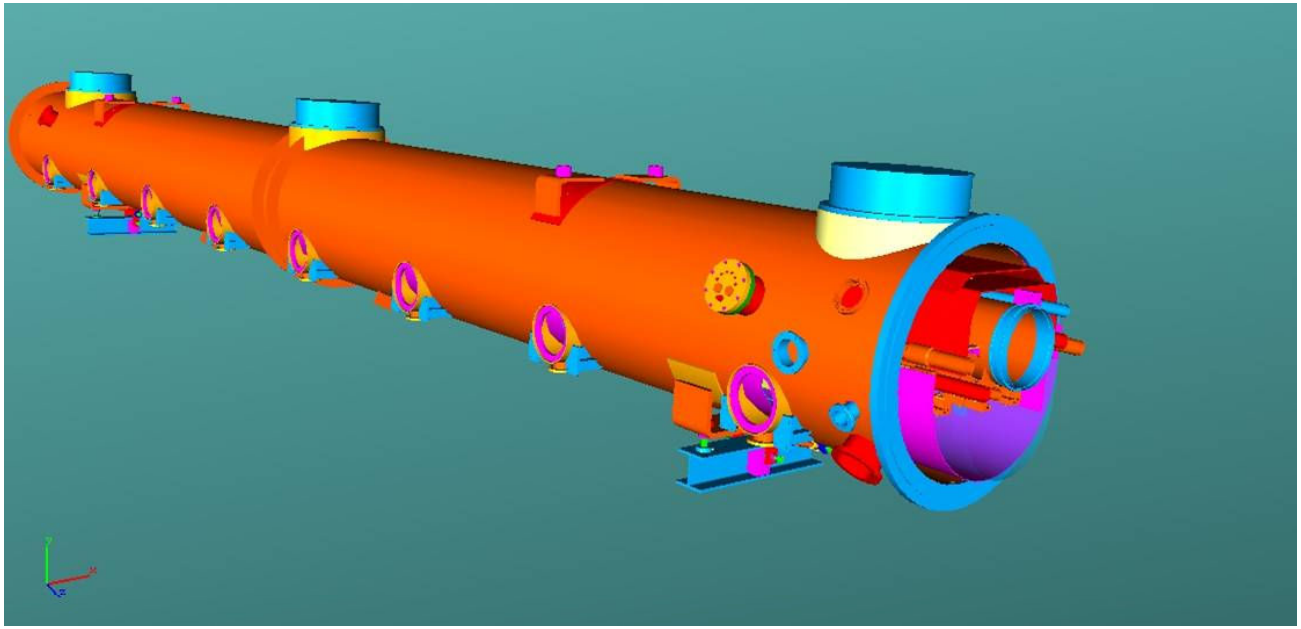


HOM coupler

cavities

European XFEL

Prototype XFEL Accelerator Modules



- **Fabrication** of XFEL prototype cold masses (incl. outer vessel)
  (based on TESLA / ILC / DESY / INFN / TTF / FLASH experience)
- **module assembly** to verify the work of three additional vendors
- **cold test** all thee modules before ordering the final XFEL series
- use the modules for **assembly training** / **further transportation checks** / XFEL injector

European XFEL

A First Cryostat Being Produced in France

irfu

cea

saclay

DESY

INFN-LASA

- Status 28.11.2008

- Vacuum vessel final welds and machining
- Cold mass final welds and machining, welds done by a additional subcontractor

European XFEL

A First Cryostat Being Produced in Spain

irfu

cea

saclay

DESY

INFN-LASA

- Status 27.11.2008

DESY HELMHOLTZ ASSOCIATION

European XFEL

A First Cryostat Being Produced in China

irfu

cea

saclay

DESY

INFN-LASA

- Status 28.11.2008

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The Chinese Module at CMTB

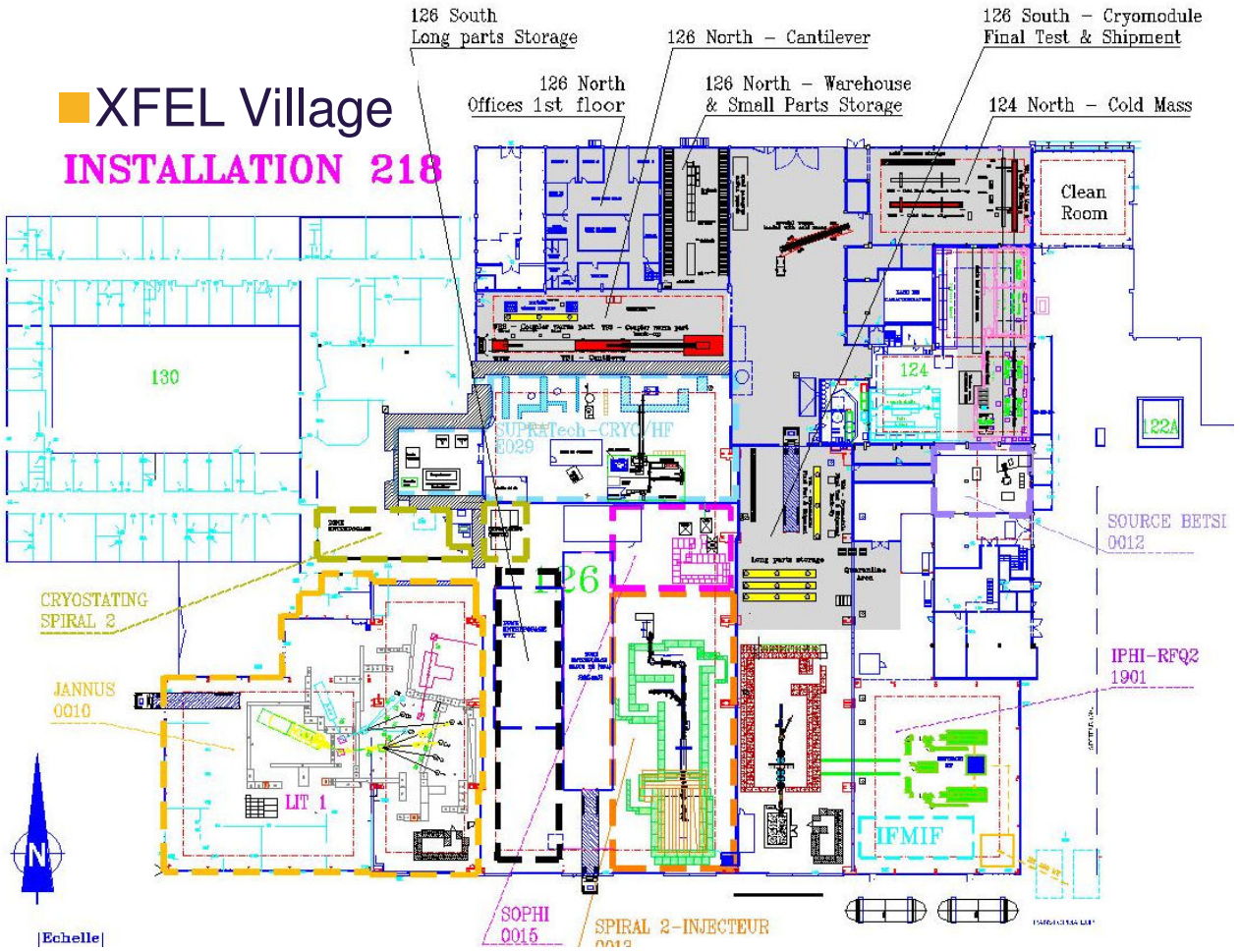
European XFEL

String and Module Assembly Site at CEA Saclay

irfu

cea

saclay



- Preliminary Industrialization Study (EPI) done by industry and handed over to CEA Saclay.

European XFEL

Building and Infrastructure

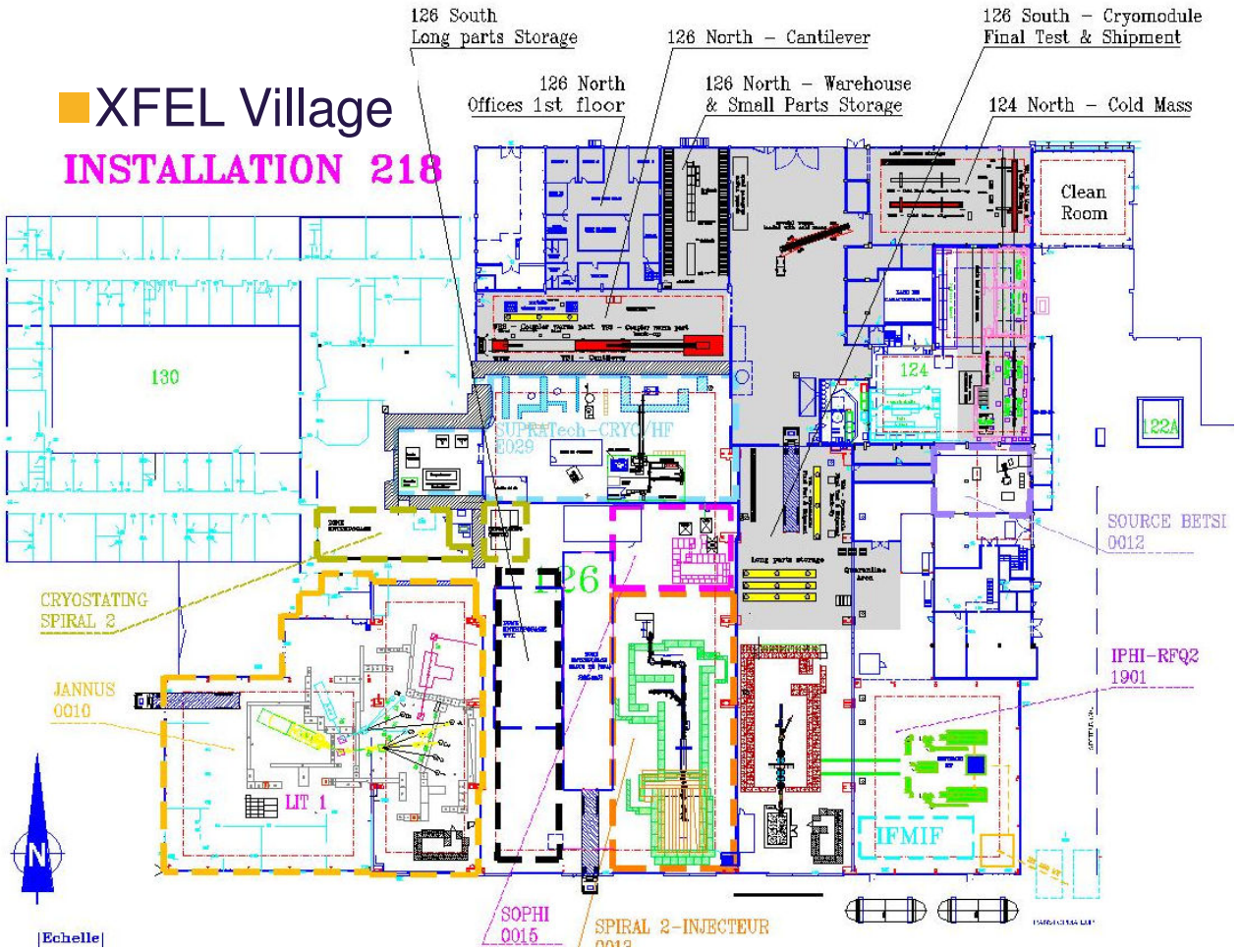
irfu

cea

saclay

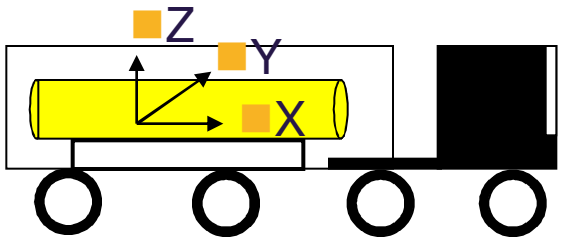
DESY

INFN-LASA



- A complete design and cost estimate for the civil engineering and general equipments is now available; construction started and is ongoing.

A "Return-Ticket" to Paris



- Saclay to Hamburg
- Zmax= 1,424 g
- ACCEL, inside frame

- Hamburg to Saclay
- Zmax= 1,11g
- ACCEL, inside frame

- From Hamburg to Saclay the tour was observed over the whole time of 24h

European XFEL

Accelerator Modules - Transportation Tools

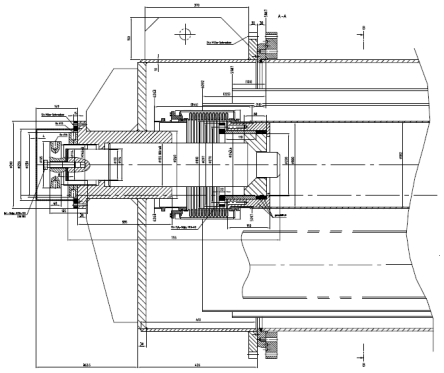
irfu

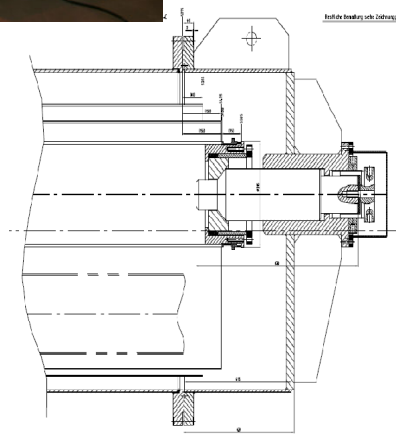
cea

saclay

DESY

INFN-LASA





■Feed-cap side

■End-cap side

European XFEL

The First Accelerator Module at CEA Saclay

irfu

cea

saclay

DESY

INFN-LASA

DESY

HELMHOLTZ ASSOCIATION

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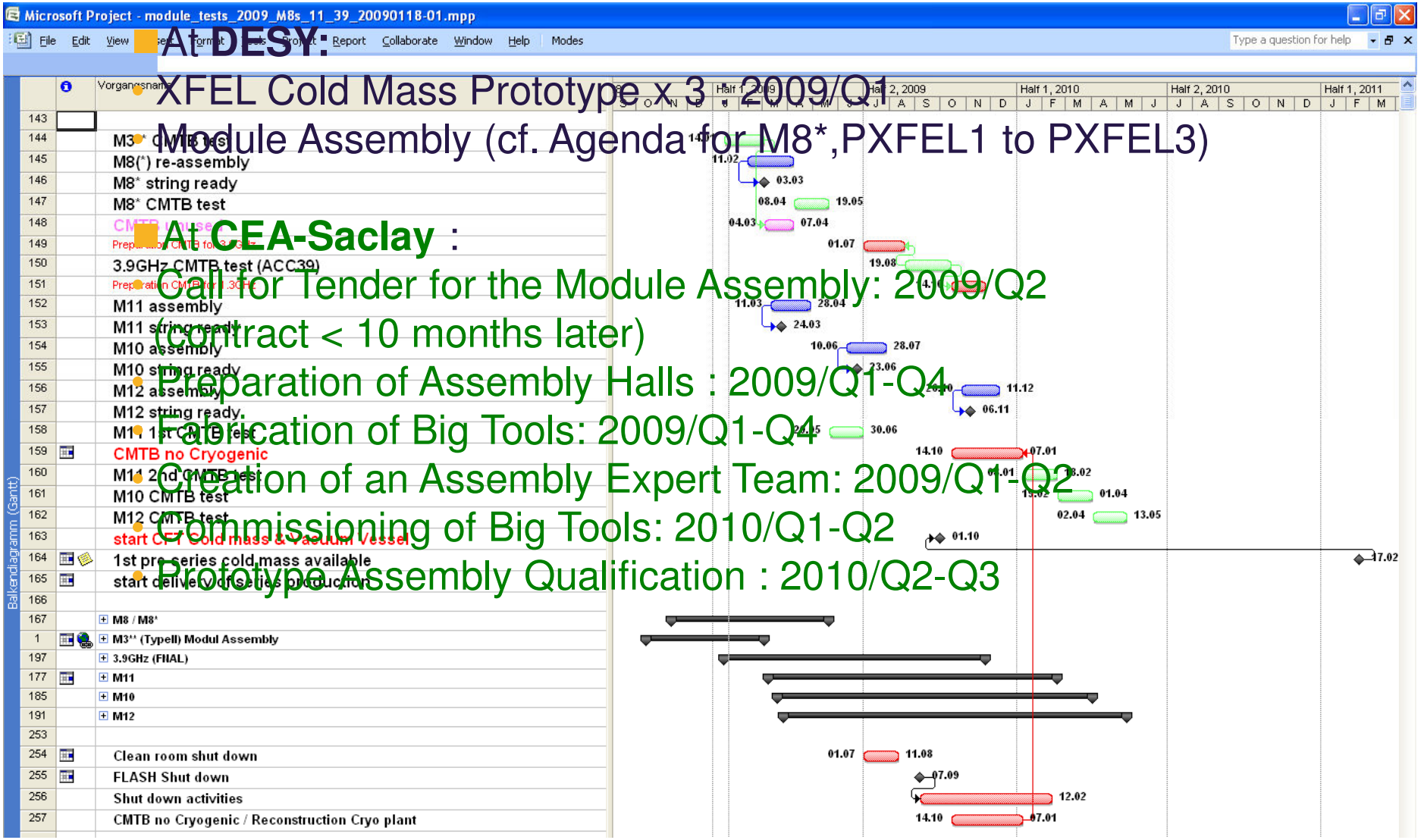
Accelerator Modules – The Plan for 2009

- At **DESY:**
  - XFEL Cold Mass Prototype x 3 : 2009/Q1
  - Module Assembly (cf. Agenda for M8*,PXFEL1 to PXFEL3)
- At **CEA-Saclay** :
  - Call for Tender for the Module Assembly: 2009/Q2 (contract < 10 months later)
  - Preparation of Assembly Halls : 2009/Q1-Q4
  - Fabrication of Big Tools: 2009/Q1-Q4
  - Creation of an Assembly Expert Team: 2009/Q1-Q2
  - Commissioning of Big Tools: 2010/Q1-Q2
  - Prototype Assembly Qualification : 2010/Q2-Q3



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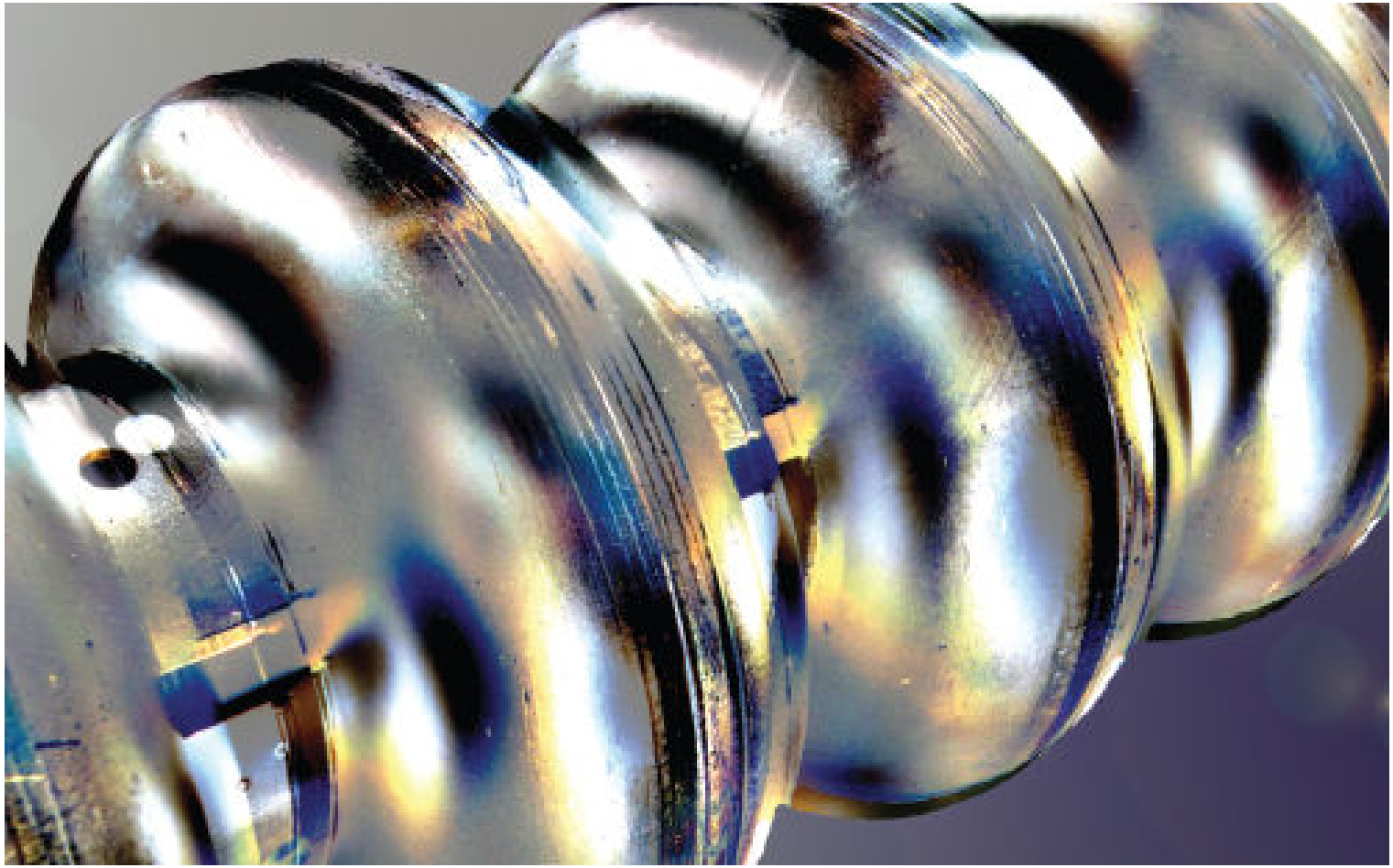
Cavities



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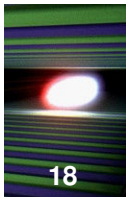
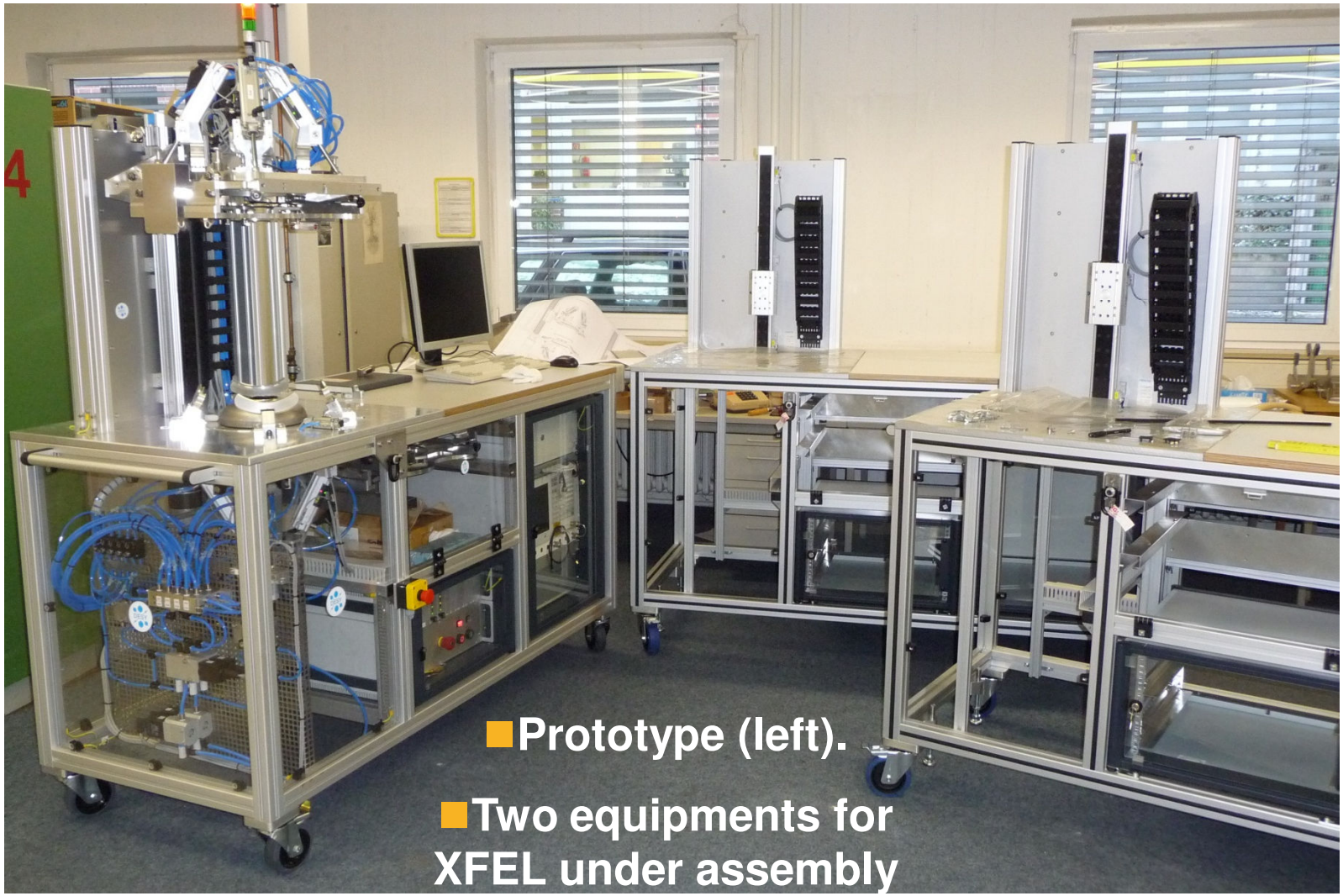
Cavities - Activities Scheduled for Q1-Q4 2009



- **final specification** for cavity mechanical fabrication with He vessel (deadline Q1 2009)
- **final specification** for cavity treatment with He vessel (deadline Q1 2009)
- **update overall plan** (cavity schedule as part of the cold linac plan)
- **Allocation of contract for cavity production (Q4 2009)**
- Fabrication of **2 equipments** for RF measurement of half cells, dumb bells and end groups HAZEMEMA (deadline Q2 2009)
- Fabrication of **2 equipments** for warm tuning (deadline Q4 2009)
- Fabrication of **2 equipments** for scanning of Nb (deadline Q4 2009)
- Equipment for optical control of inside surface (rented at KEK and installed at DESY)

Equipment for RF Measurement of Dumb Bells and End Groups: HAZEMEMA



- Prototype (left).
- Two equipments for XFEL under assembly

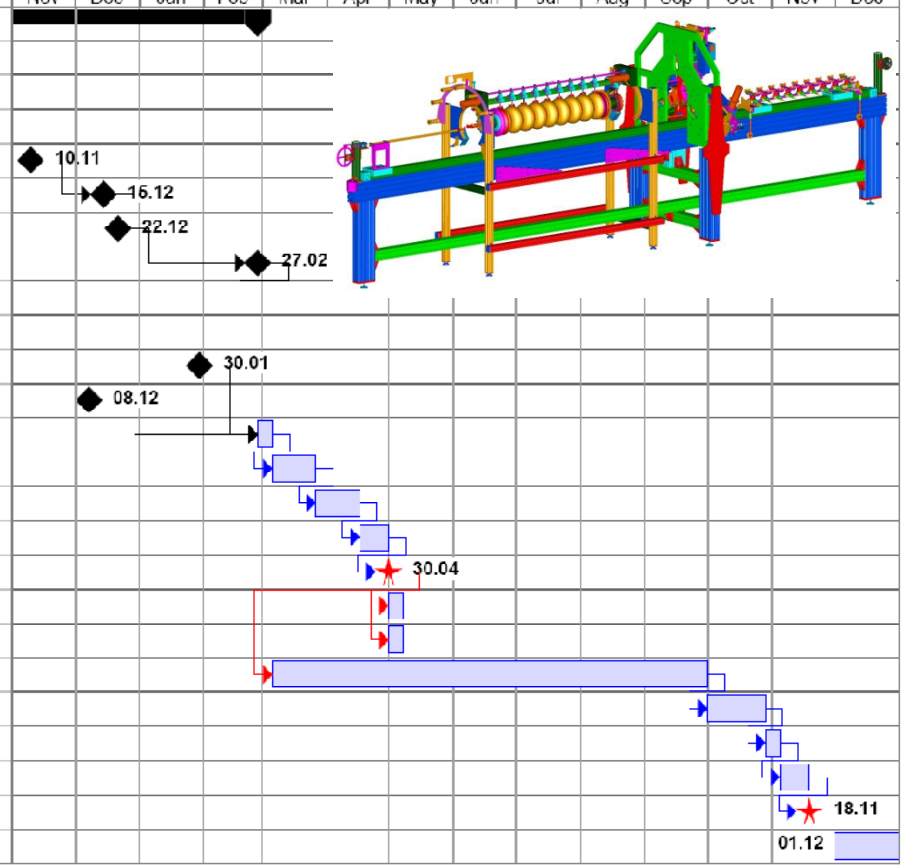
European XFEL

Cavities – Field Flatness Tuning

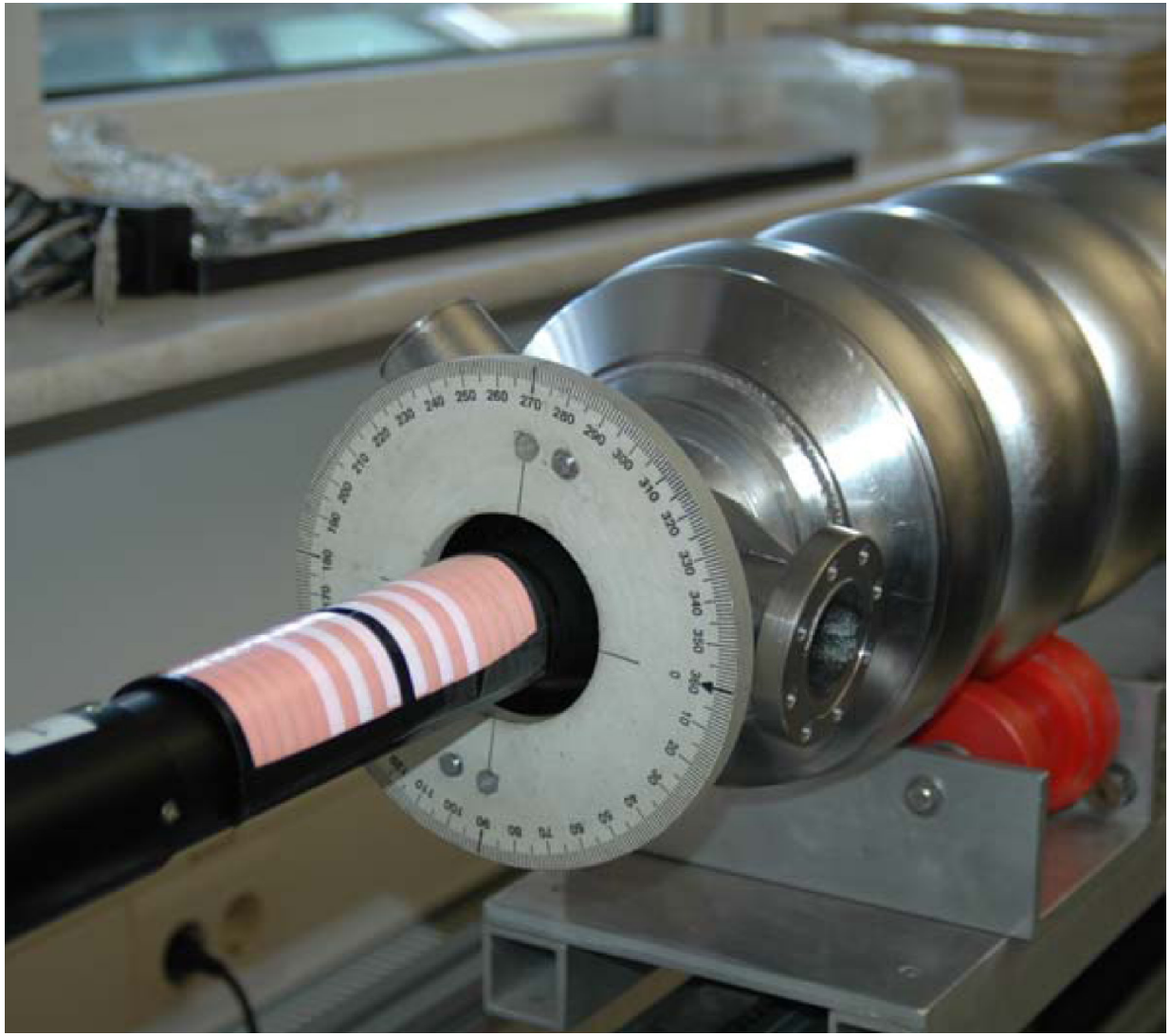
Tuning Machine - Fabrication Milestones

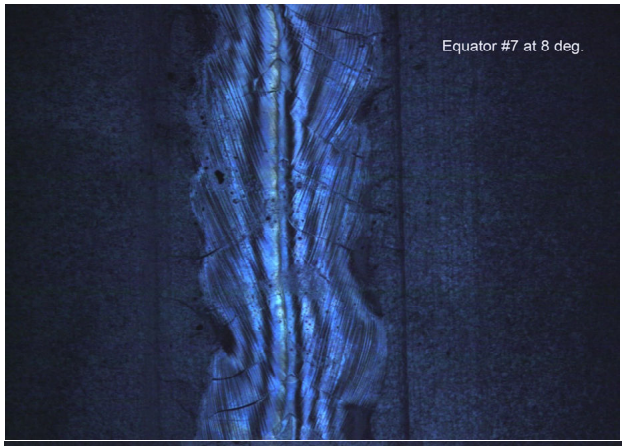
2008 April, 23rd
1. update 2008 July, 22nd
2. update 2008 December, 01st

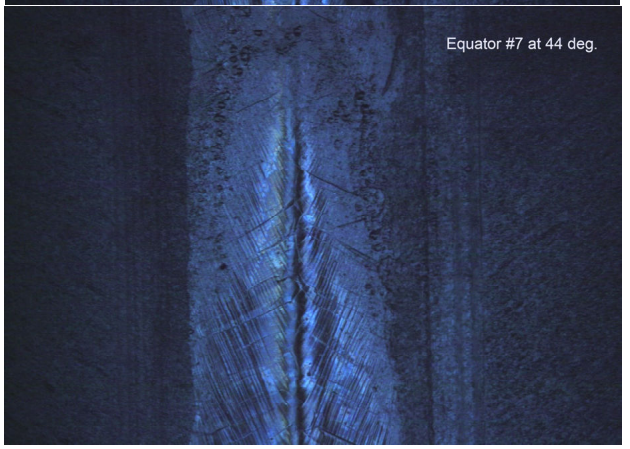
ID	Vorgangsname
1	**Tuning Machine - Fabrication Milestones**
2	tuning frame finished
3	base frame finished
4	linear slide system finished
5	Redesign of the cavity train finished
6	Fabrication of redesigned CT parts completed
7	Redesign of tuning jaw, protective shields, connection end rings finished
8	Fabrication tuning jaw, protective shields, connection end rings finished
9	bead pull system finished
10	wire input tooling finished
11	DELAYED / eccentricity measurement device finished
12	machine housing delivery
13	**Final mechanical checks and adjustments**
14	**Wiring of the entire machines**
15	**Final electrical checks**
16	**Packing and shipping of #1 and #2 to FNAL**
17	**Machine #1 and #2 at FNAL**
18	**Assembly of CTM #1 at FNAL**
19	**Shipment of sluice #1 to DESY**
20	**Remainder of controls**
21	**Comissioning of control system on CTM #1**
22	**Shipment of control system #3 and #4 to DESY**
23	**Commisioning of control system at DESY**
24	**Machine #3 and #4 ready for XFEL**
25	**XFEL - pre series cavity tuning at DESY (expected !)**



High Resolution Kyoto -Camera of KEK Adapted to Optical Entrance Control at DESY



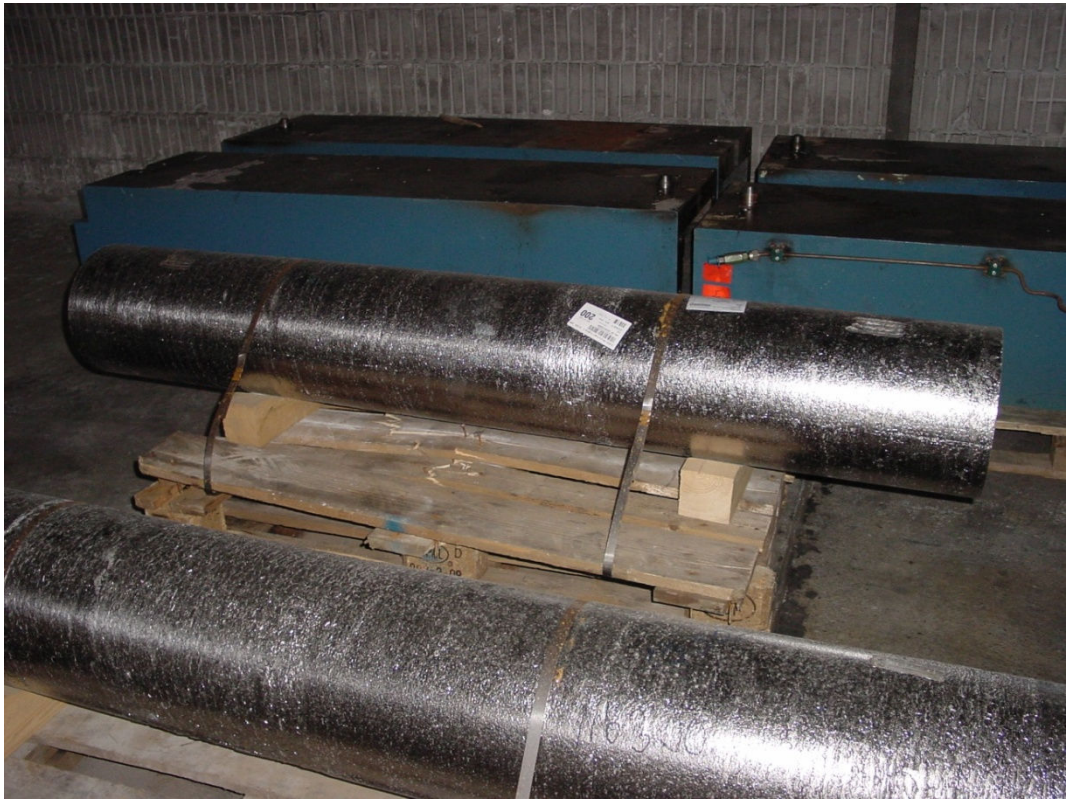




- Under preparation:
  - automation
  - set up for cavity inspection with He vessel

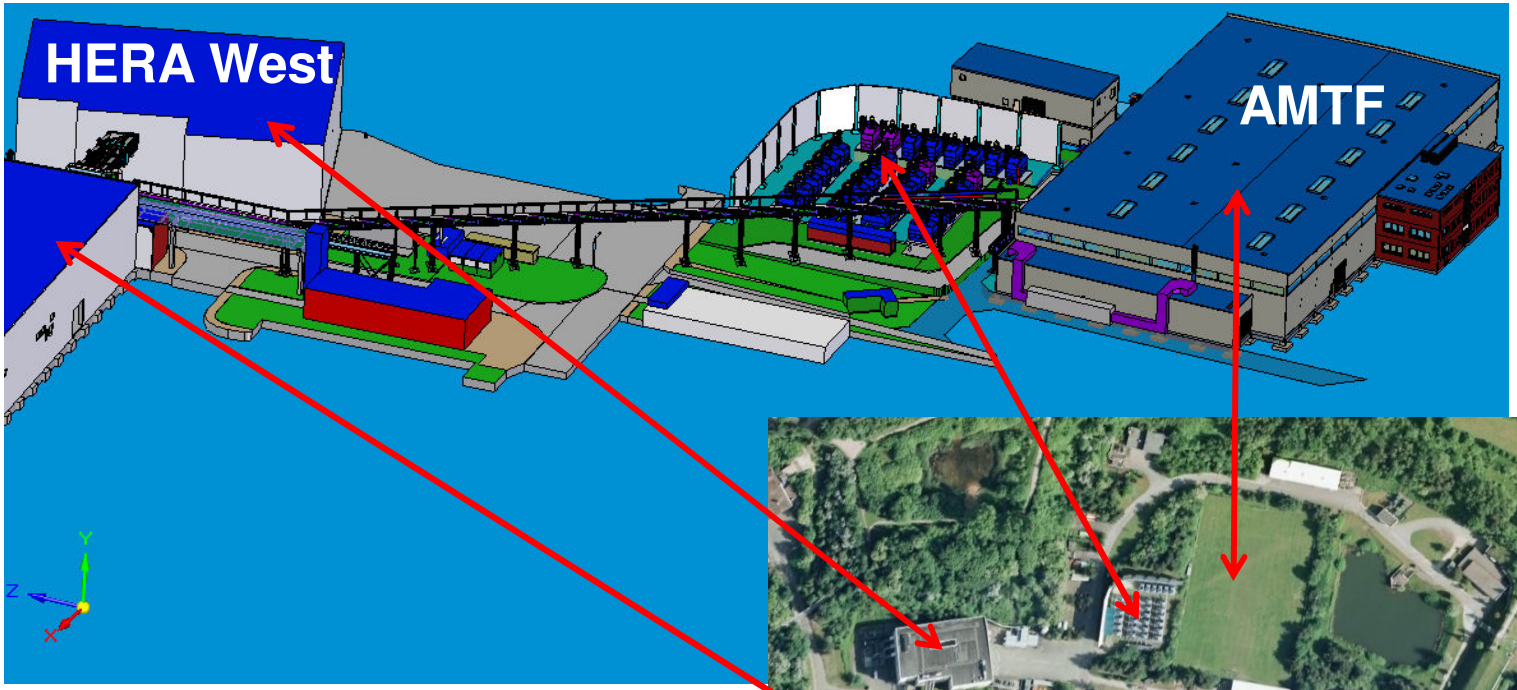
European XFEL

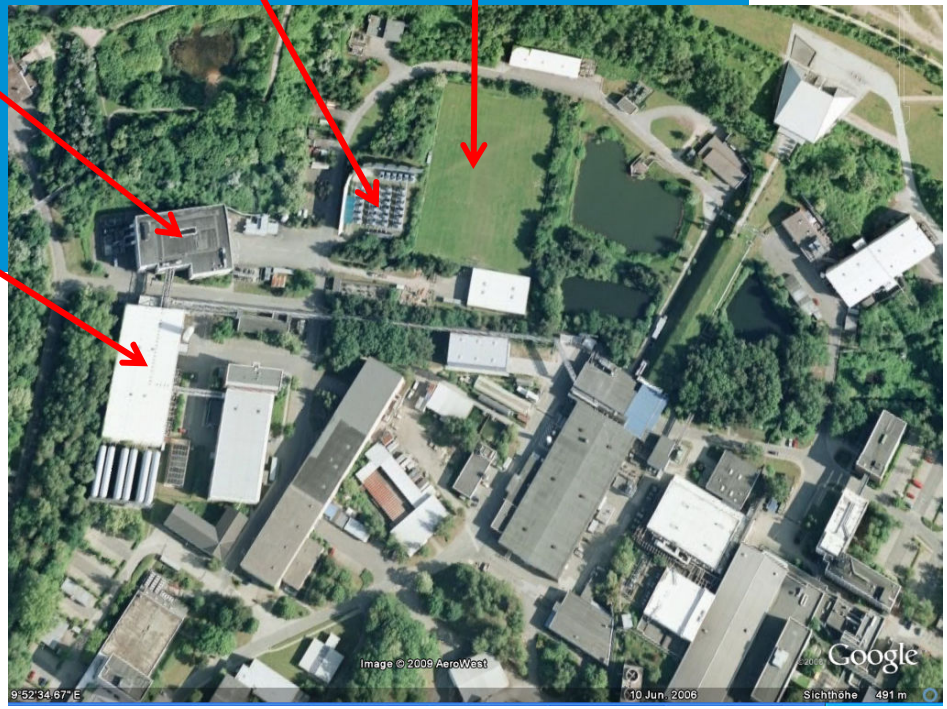
Cavities – Let's Start with the Pre-series



- Purchase niobium and flange material (not sheets) for 30 pre-series cavities ordered
- ingots delivered, cutting of sheets under way
- Scanning of the Nb sheets for 30 pre-series cavities is next

Accelerator Module Test Facility (AMTF) Including single Cavity tests





- First cavity tests required for 1/2011
- Commissioning of module test facility 4/2011
- AMTF ready for infrastructure installation 3/2010

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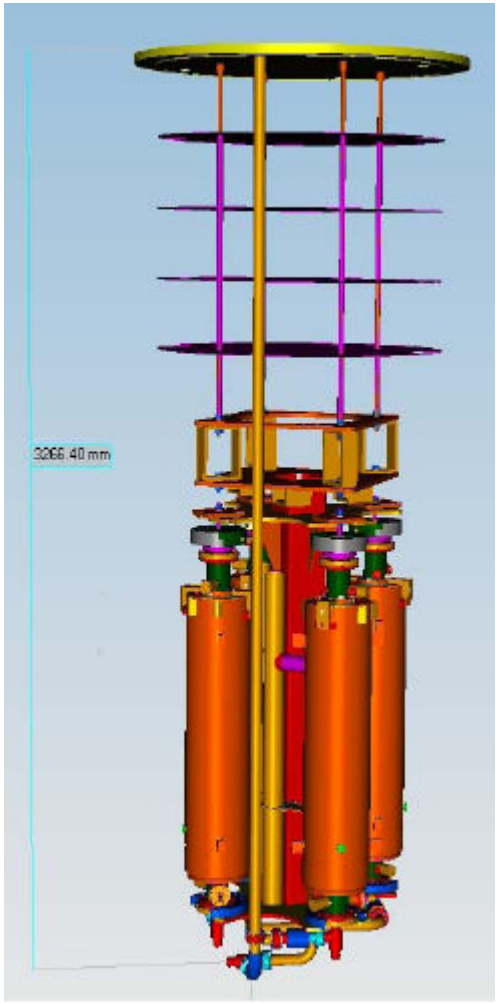
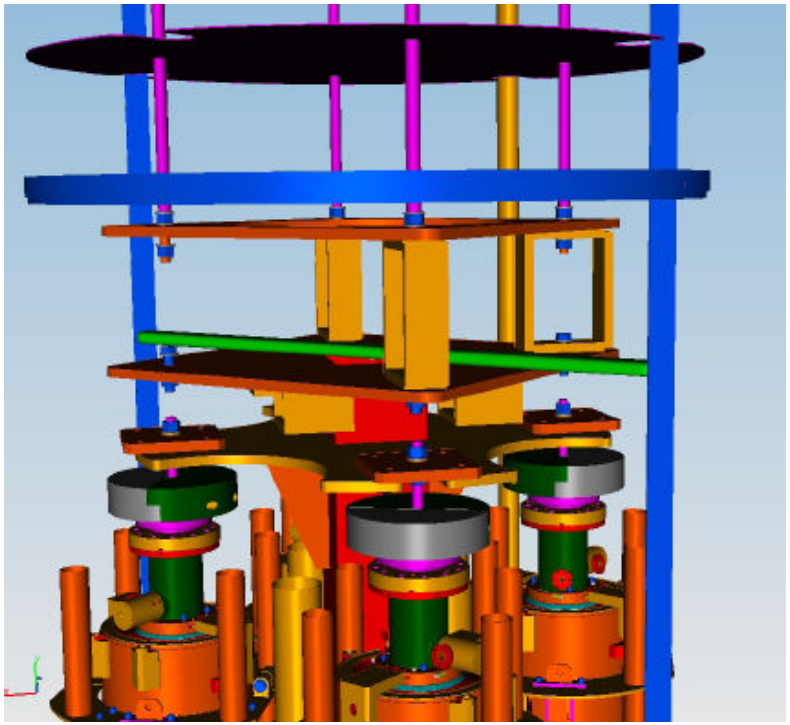
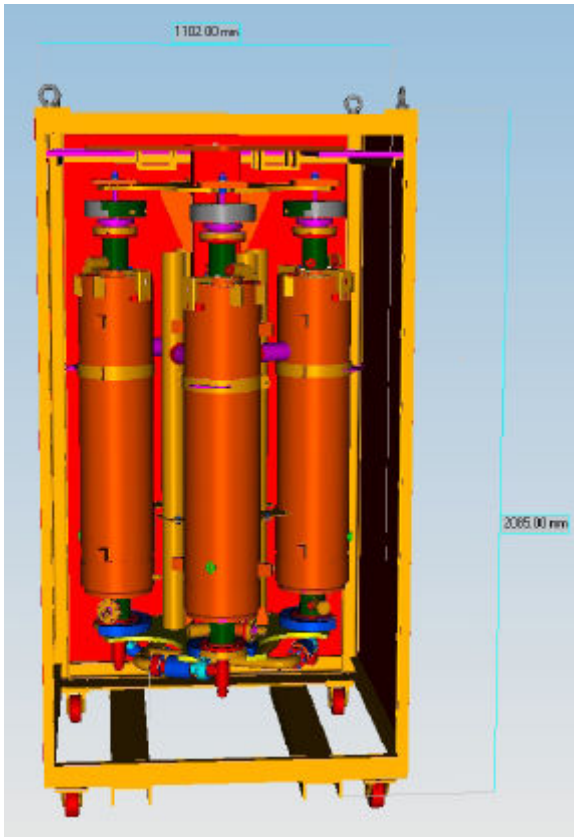
Cavity Tests at AMTF Starting in 2011





- 4-cavity insert for AMTF test cryostats; design ready, construction a.s.a.p.

- Transportation frame; actual design, tests with single cavities on-going



European XFEL

RF Power Coupler – LAL Orsay Contribution

WP 1 – Waveguide
- 1.1 Waveguide flange, bolts and nuts
- 1.2 Kapton window

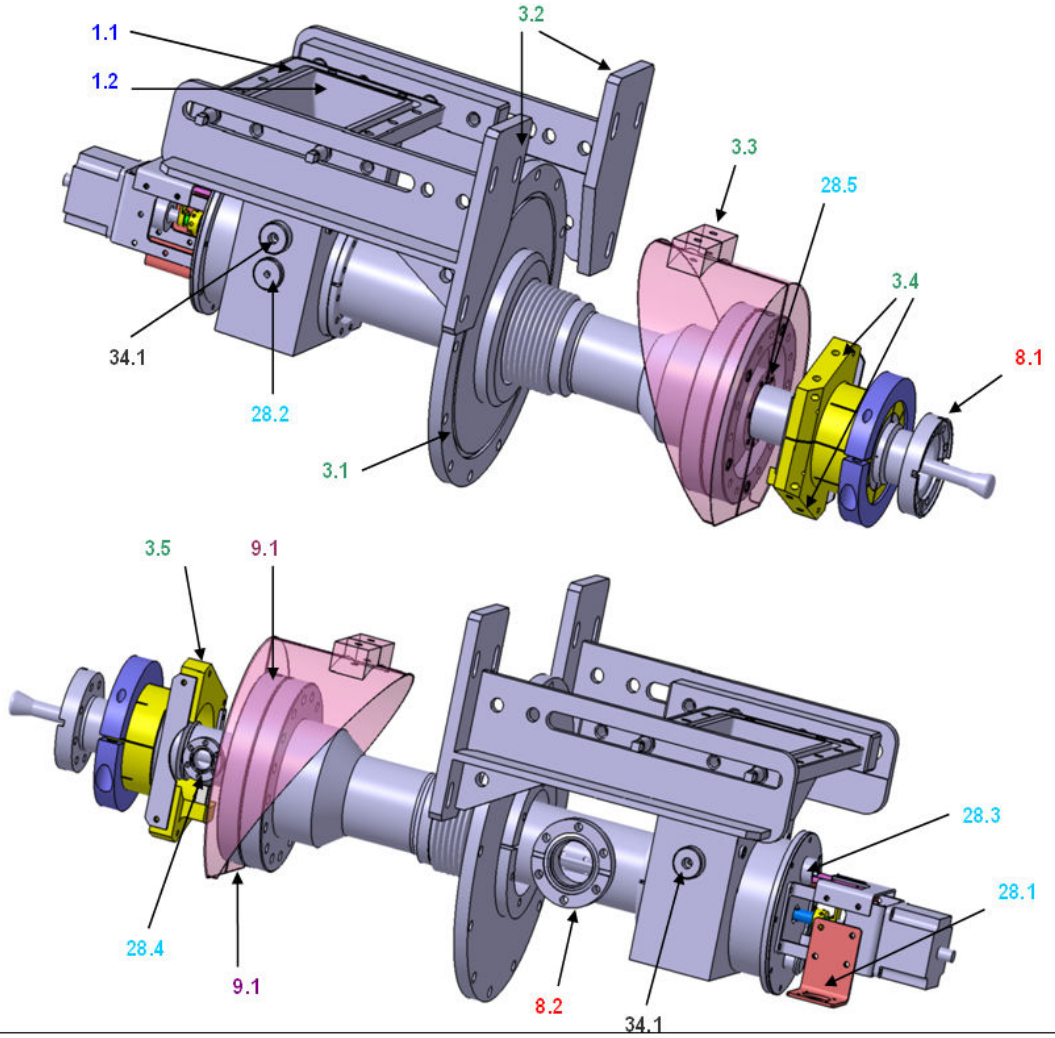
WP 3 – Cryomodule
- 3.1 Flange on vacuum vessel, gasket, bolts
- 3.2 Coupler supports (left & right), bolts
- 3.3 Connection of Cu braids from 80K thermal shield, bolts
- 3.4 Connection of Cu braids from 4K thermal shield, bolts
- 3.5 4 holes in 4K interface for assembly rods
- 3.6 Super insulation

WP 8 – Cavity & vacuum
- 8.1 Cavity flange, gasket, bolts & nuts
- 8.2 Coupler vacuum pumping port, gasket, bolts & nuts

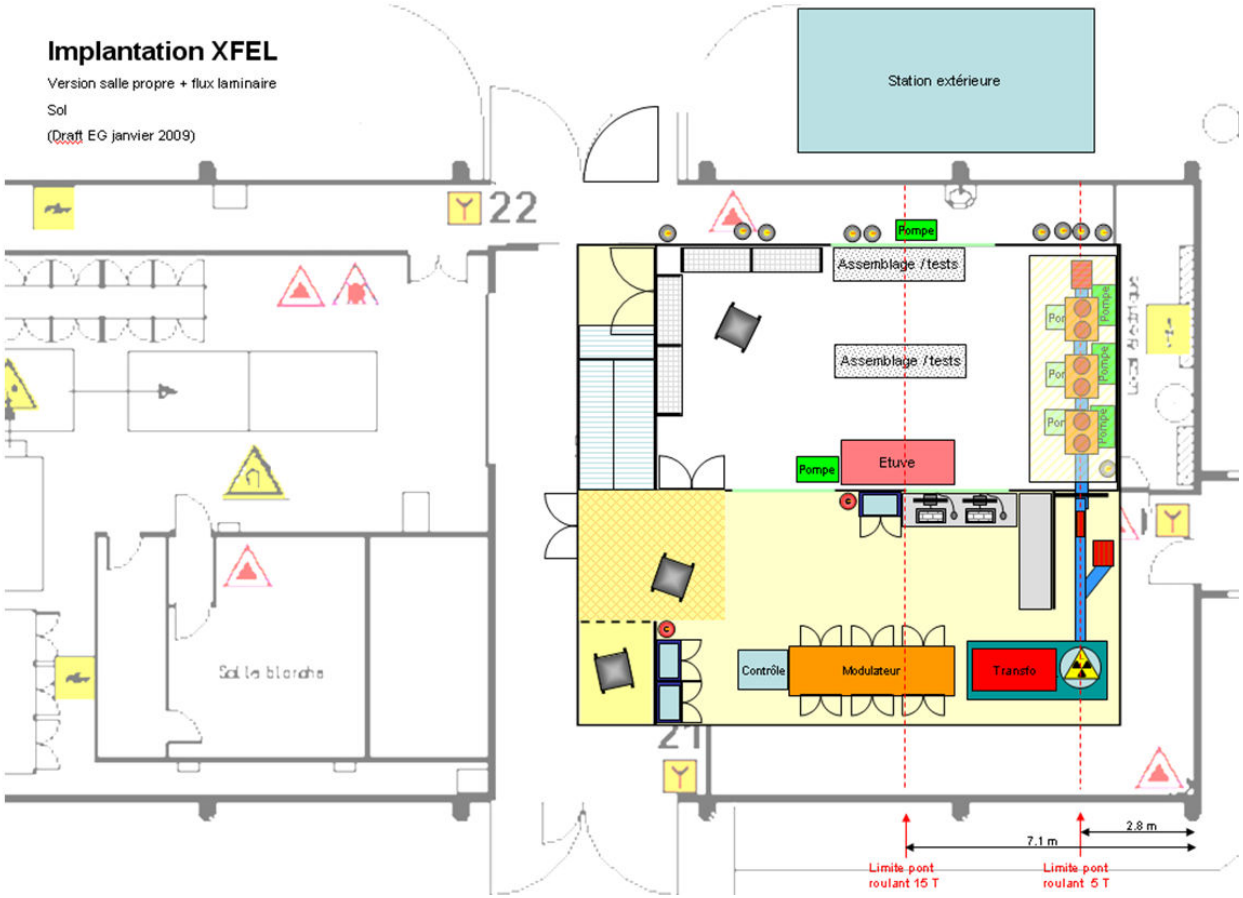
WP 9 – Cavity string assembly
- 9.1 Two holes in big cold flange
- 9.2 Clamp for cold bellows

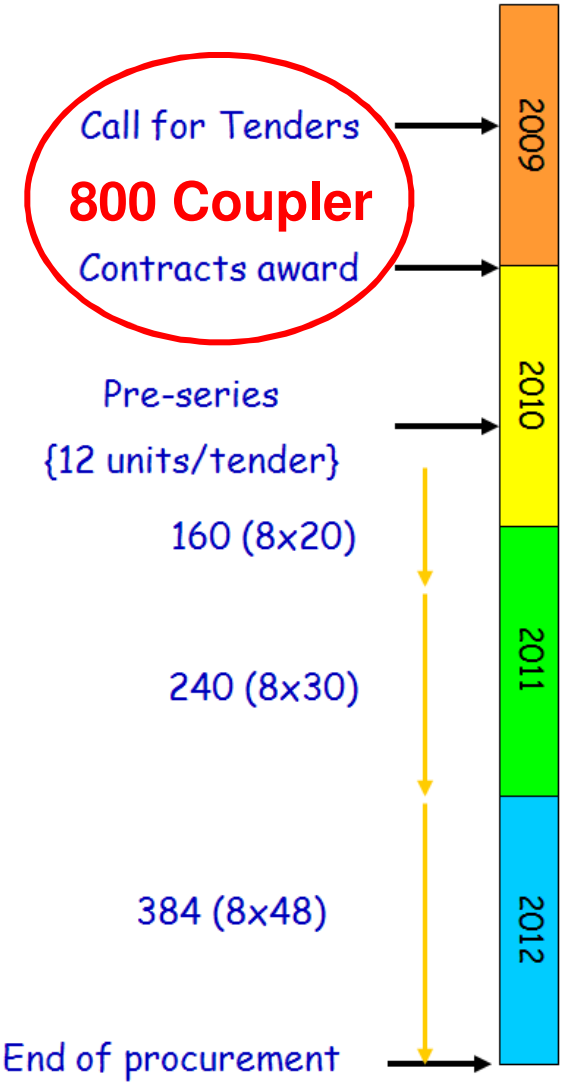
WP 28 – Control system
- 28.1 Connector for motor, end switches, PT100
- 28.2 Arc detector
- 28.3 HV connector
- 28.4 e- pickup
- 28.5 2 sensors PT100 in 80K zone

WP 34 – Utilities
- 34.1 Two N2 cooling ports
- 34.2 Environmental conditions: T, P, H, radiations



Future LAL RF Station for XFEL Coupler Conditioning





- RF station ready for commissioning beginning of 2010.

Cavity Frequency Tuner – Assembly and Test Procedures

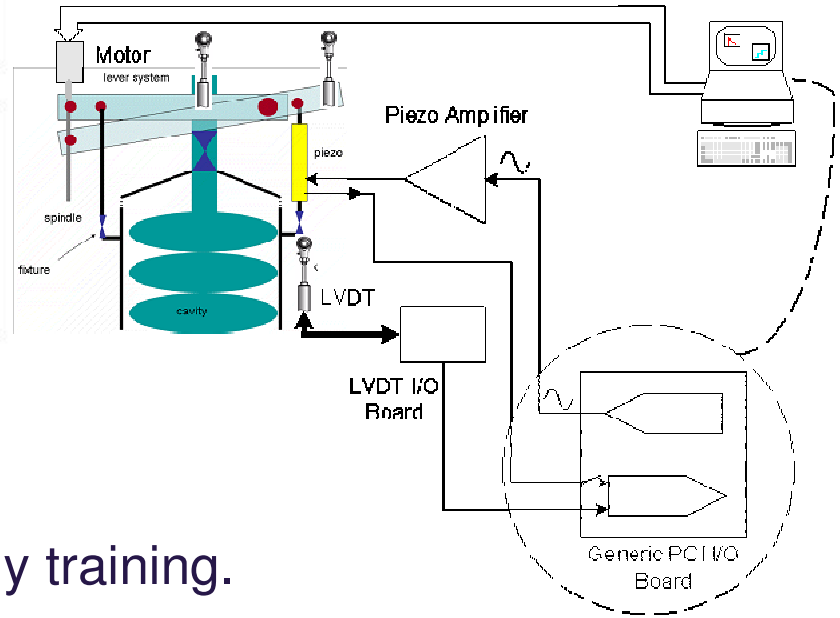








- An **automated test procedure** proposed by INFN is under preparation for AMTF tests.



- Detailed **assembly procedures** are prepared for string and module assembly training.

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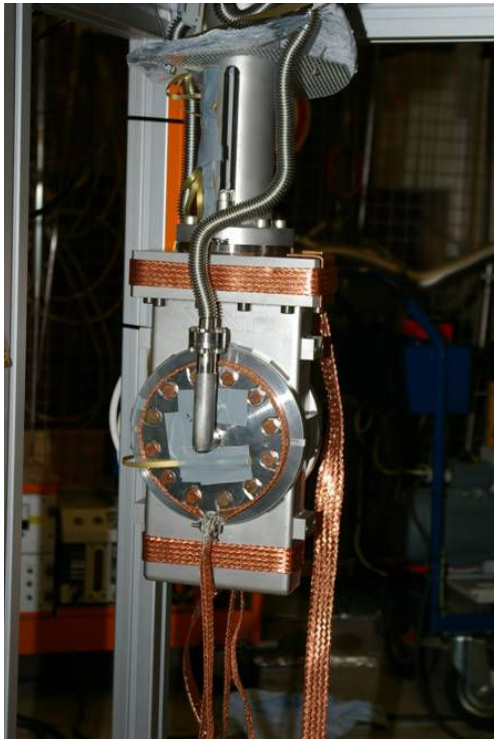
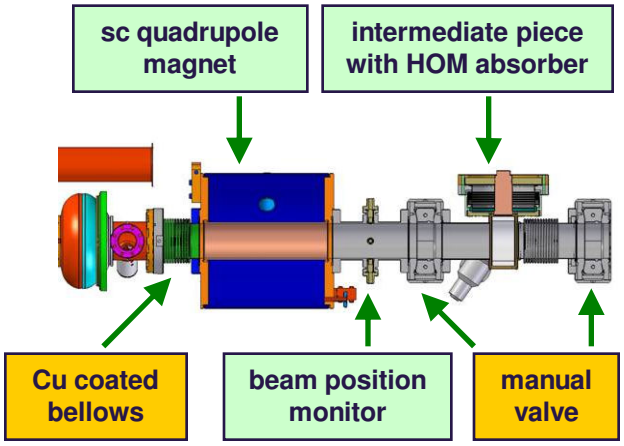
Cold Vacuum Requires Special Attention

- An automated slow **venting system** is under preparation for all kind of cavity / string / module interventions.

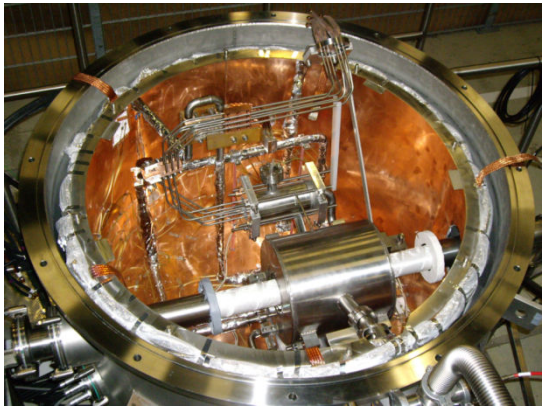


- A **cold valve** to separate beam vacuum at string connection boxes in case of catastrophic events.

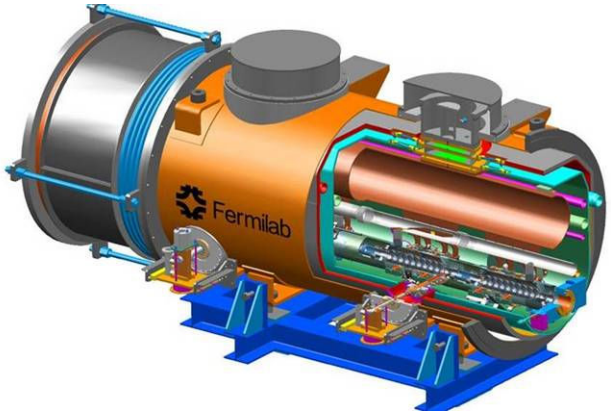


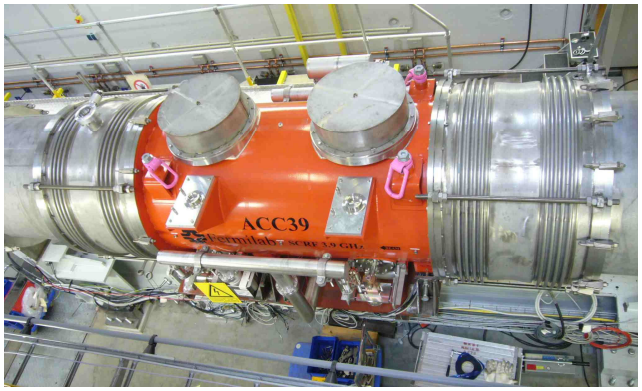
- **High Order Mode absorbers** at the end of the accelerator modules.

Many More Components, e.g. Cold Magnets, 3.9 GHz Acceleration, RF Systems …



The first **cold magnet** in the test cryostat.





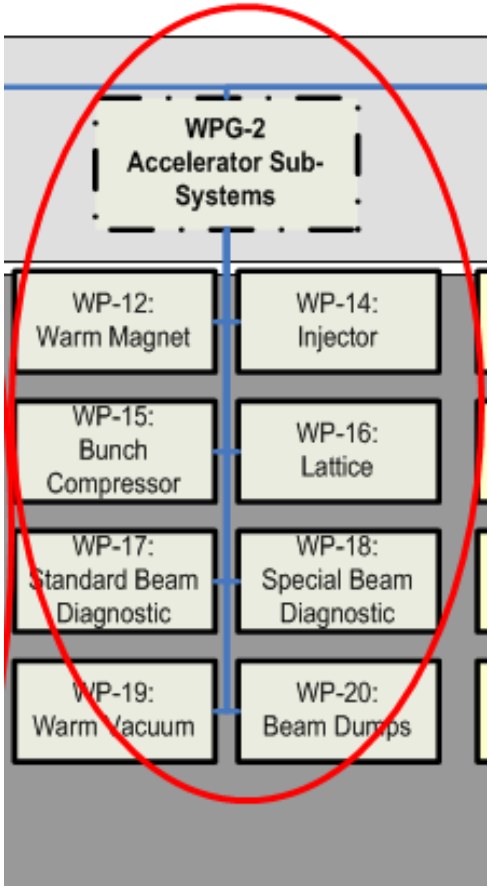
The **3.9 GHz** accelerator module delivered in spring 2009.

Test stand @ DESY, Zeuthen

RF system R&D at DESY.

European XFEL

The Warm "Linac"



- warm magnets
- bunch compressors
- beam diagnostics
- warm vacuum
- injector
- lattice
- beam dumps

DESY HELMHOLTZ ASSOCIATION

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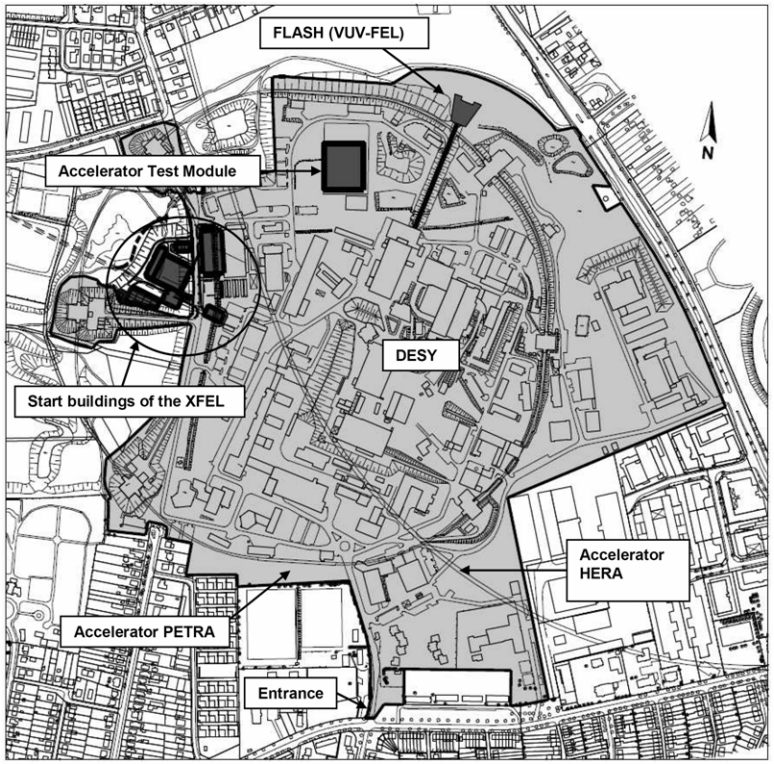
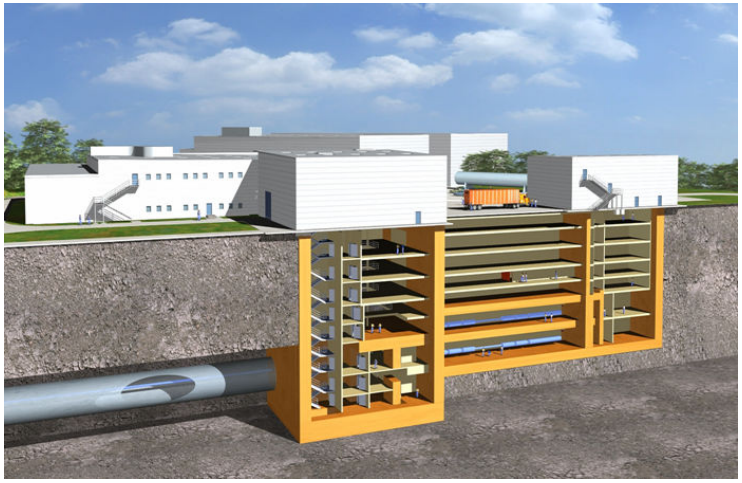
XFEL Injector





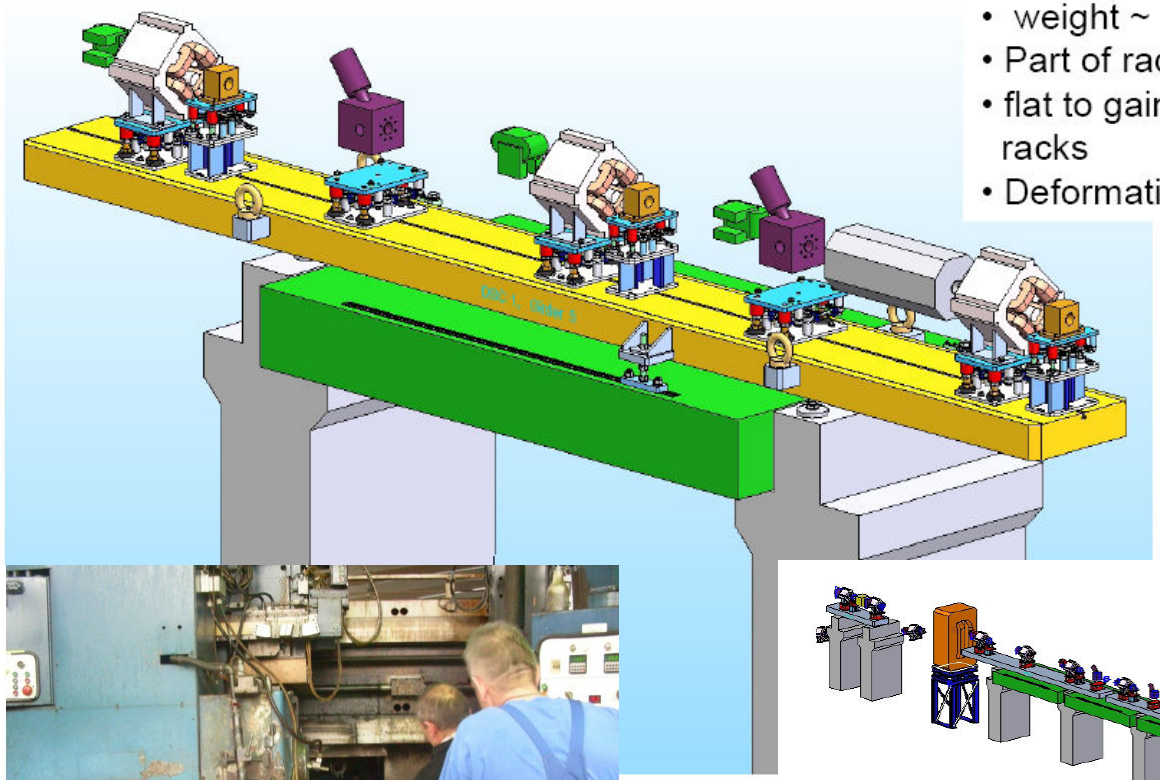
- **Construction work** has started.
- The XFEL injector is to quite some extent a copy of the TTF/FLASH Linac.

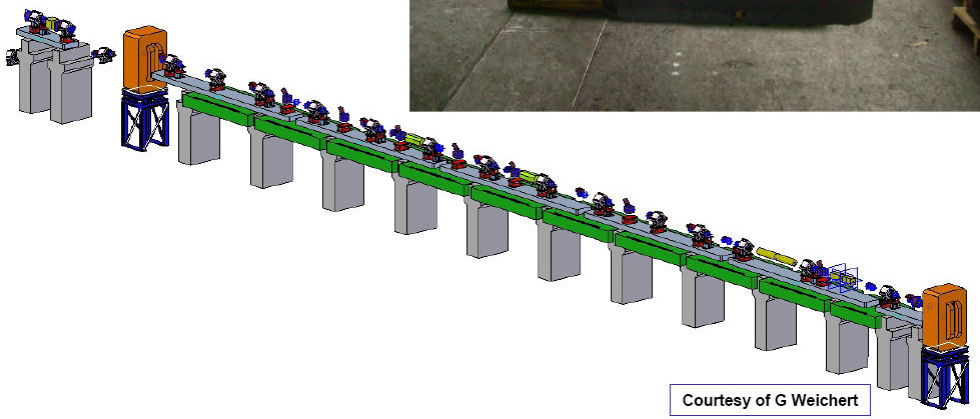
European XFEL

Solid Steel Girder in Warm Linac Sections

Solid Steel Girder:

- 4600mm x 450mm x 120mm
- weight ~ 2 t
- Part of radiation shielding
- flat to gain space for electronic racks
- Deformation: < 0.15 mm





Courtesy of G Weichert

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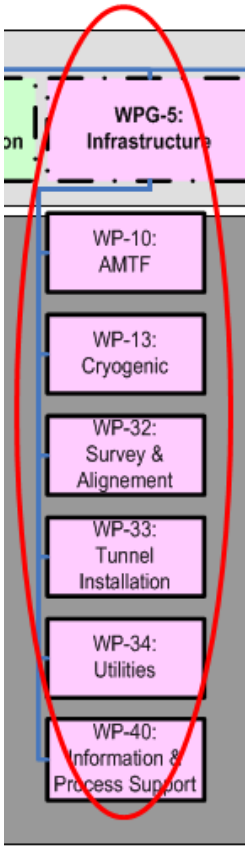
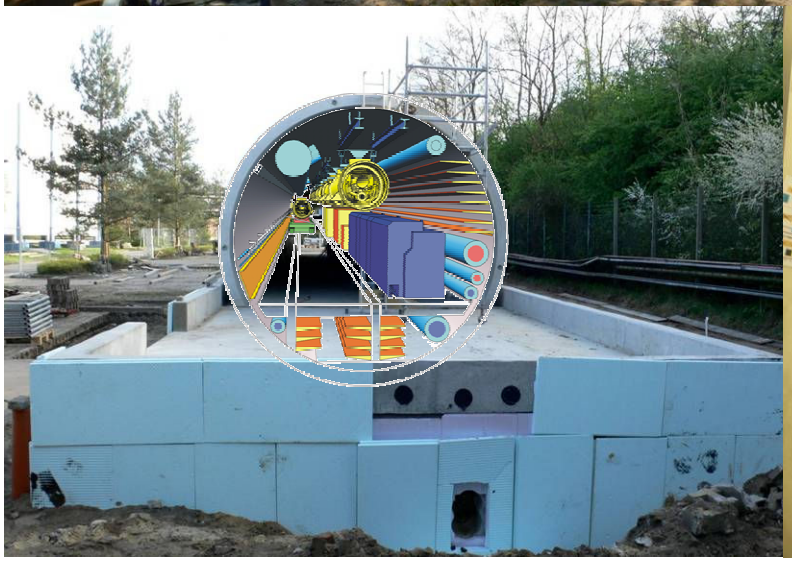
Infrastructure



- Accelerator Module Test Facility
- cryogenics
- survey and alignment
- tunnel installation
- utilities
- information & process support

Tunnel Mock-up Completed and Installations Ongoing & to be Continued



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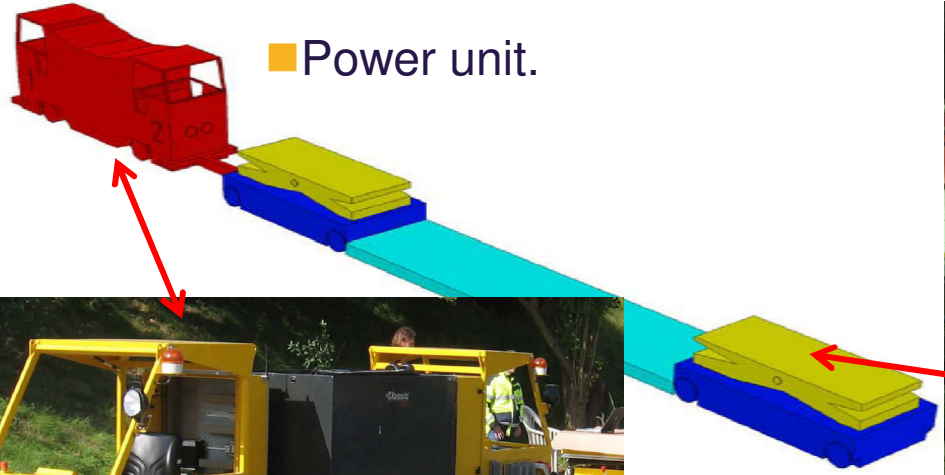
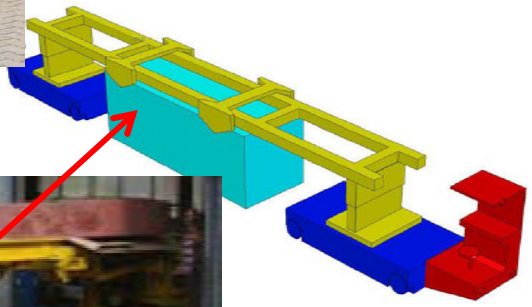
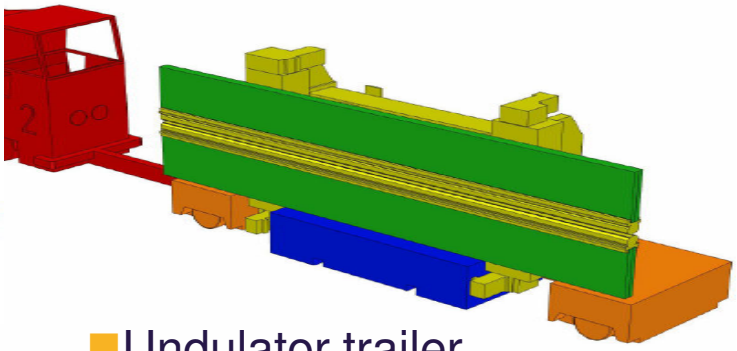
Transportation in the Tunnel



- Power unit.

- Platform trailer with scissor lifts for accelerator modules.





- Undulator trailer (still under design).

- Load train for e.g. pulse transformers.

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Collaborative Design – A First Workshop

The European X-Ray Laser Project XFEL X-Ray Free-Electron Laser

What is Collaborative Design?

- complex facilities are developed via the interaction of many, sometimes thousands of participants, who are working concurrently on different elements of the design
- collaborative design aims to provide a systematic approach for integrating their design contributions
  - aiming to converge on a single design that is acceptable to all participants
- a complete product design includes the requirements on the product, the specification[1] of the product, and the processes[2] for mastering the product through its lifecycle
  - [1]specification includes geometry, materials, properties, behavior
  - [2]processes: e.g. manufacturing, operation, maintenance support

compiled from input of various sources of literature

T. Hott, L. Hagge: Report from the 1st Workshop on the XFEL Collaborative Design Effort
22.10.2008

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- coordination issues
- standards
- project management
- use of centrally offered methods and tools

DESY HELMHOLTZ ASSOCIATION

Collaborative Effort

Many thanks to:

- WP(C)Ls
- THE experts
- my colleagues in the coordination team.