



Accelerator Status

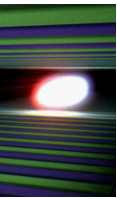
Presented at the

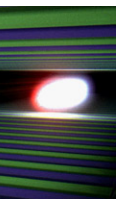
1st Meeting of the European XFEL Accelerator Consortium

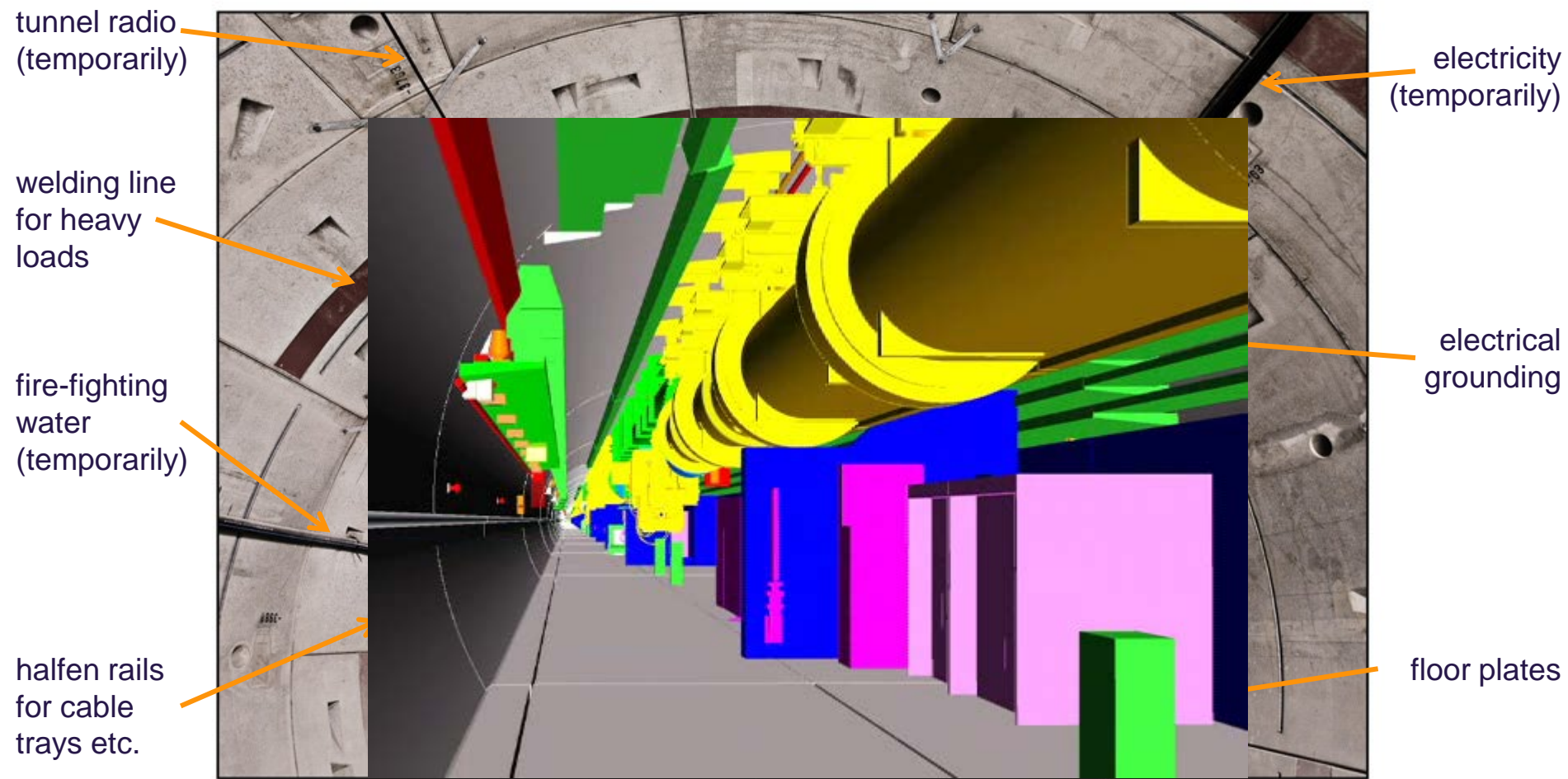
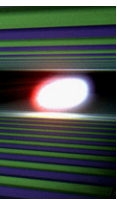
April 16 – 19, 2012

Hans Weise

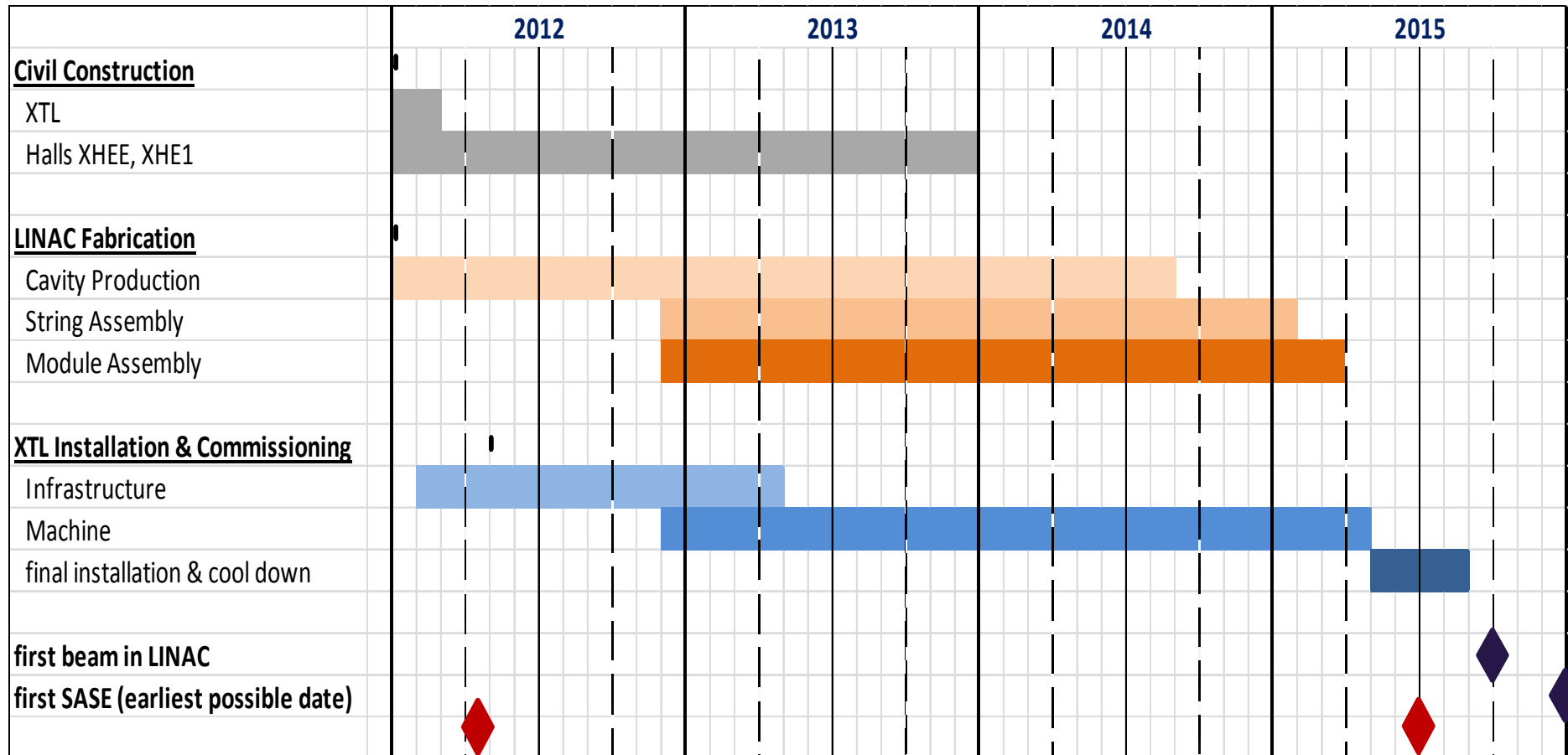
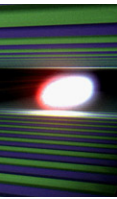




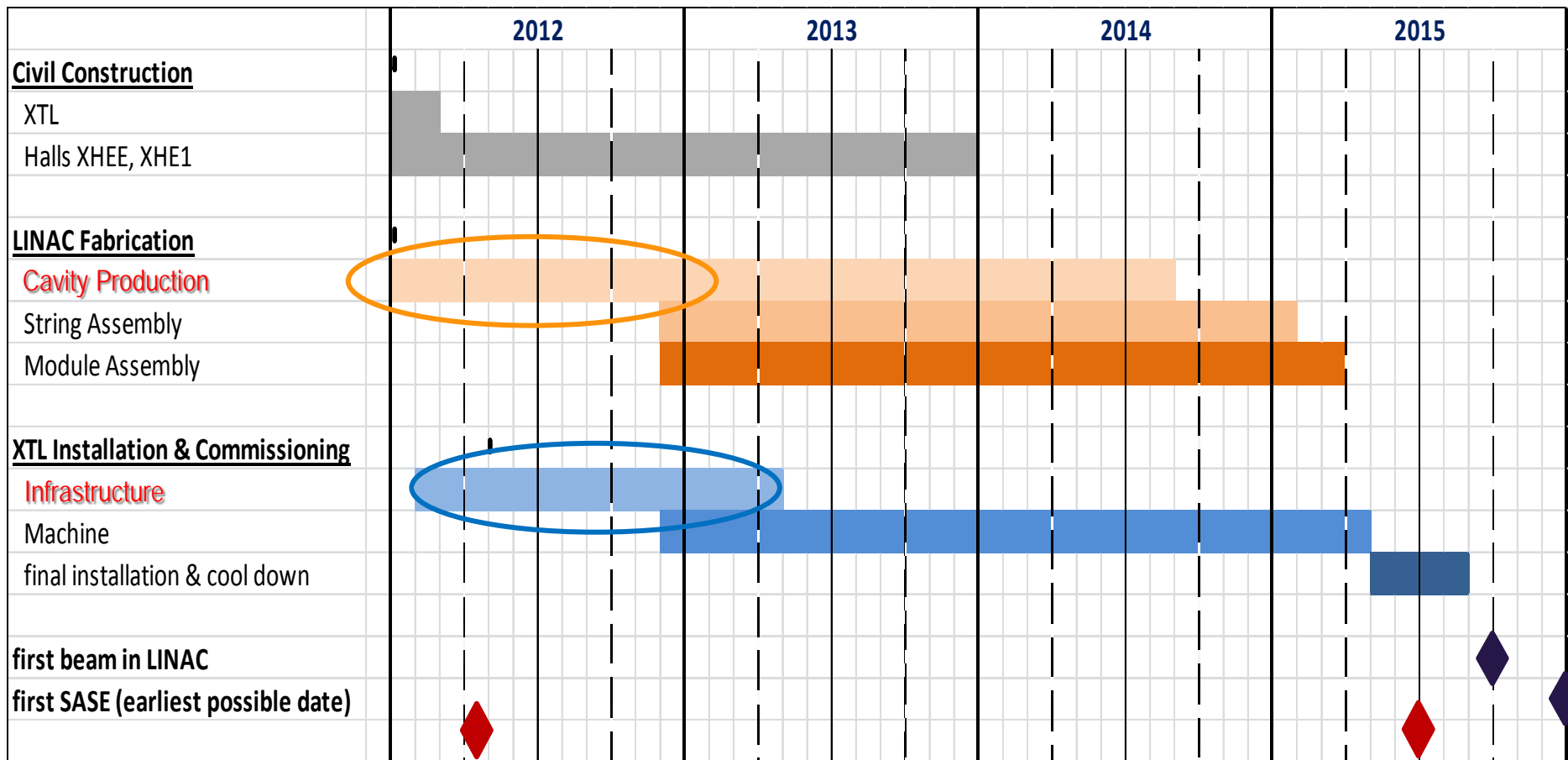
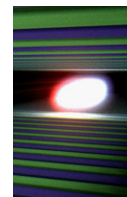




Beam Dump

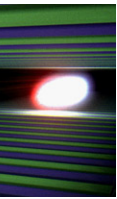


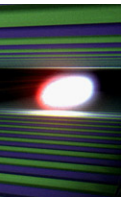
← 1,170 days, i.e. 167 weeks. i.e. 38.5 months, i.e. 3.2 years →



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Cavity Production



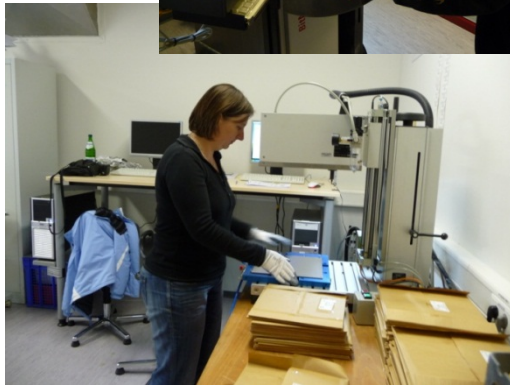


- Eddy current scanning of XFEL niobium sheets at DESY

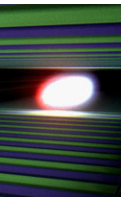
- Equipment for tactile 3D dimension measurement



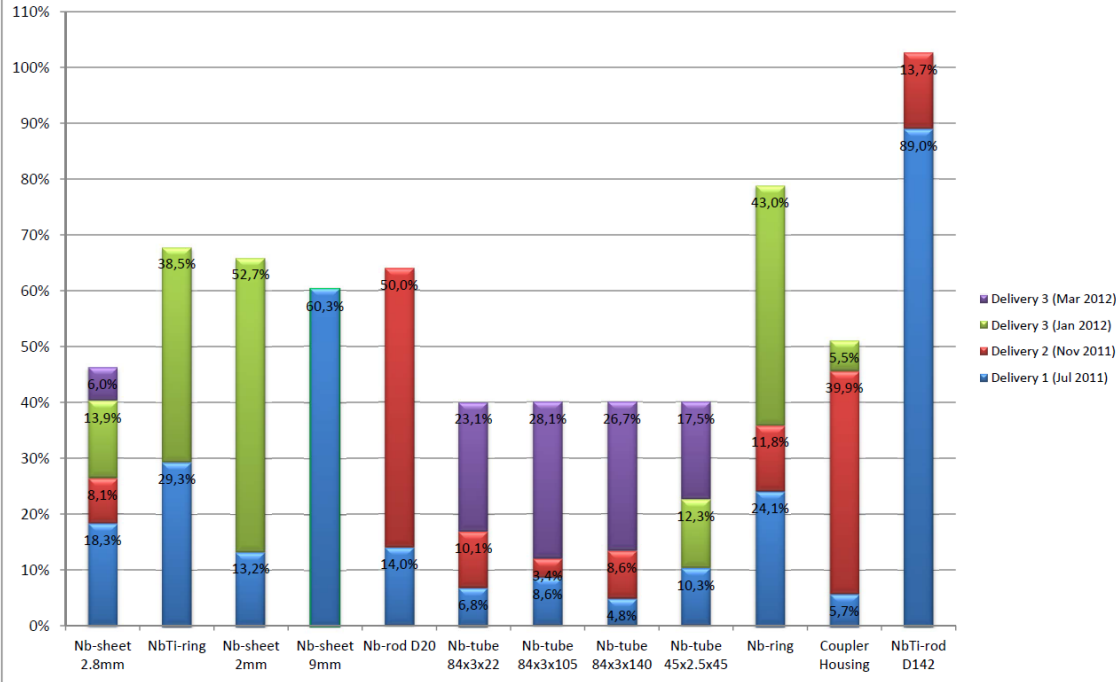
- More than 6,000 niobium sheets arrived, the next 2,000 to come soon.
- In average 40% of all niobium incl. tubes etc. delivered to cavities vendors (status 3/2012).
- Material for remaining 160 cavities contracted.
- Reference cavities from both companies arrived and currently tested.
- Commissioning of infrastructure at cavity vendors is next.
- First cavities expected for summer 2012.



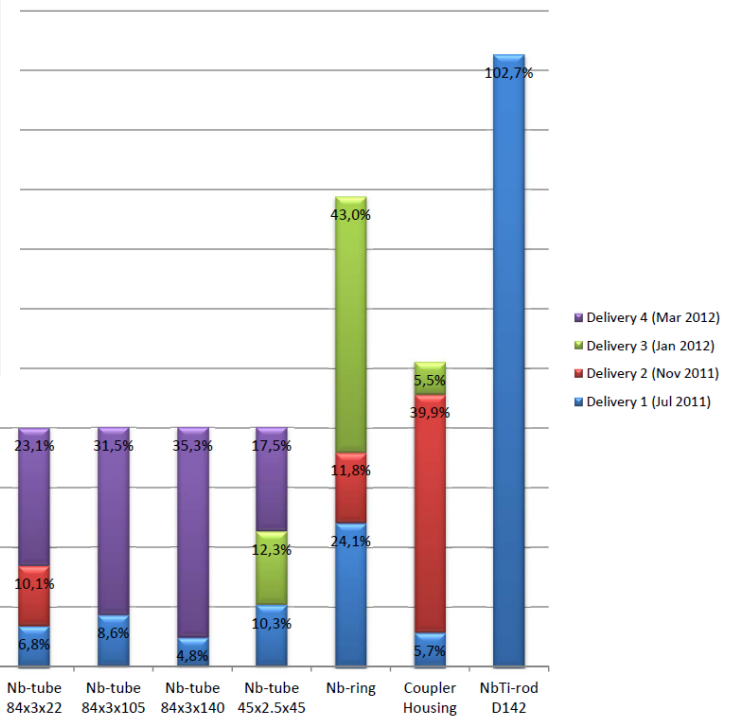
- Equipment for sheets marking



Supply of Nb/NbTi semi-finished products to Research Instruments



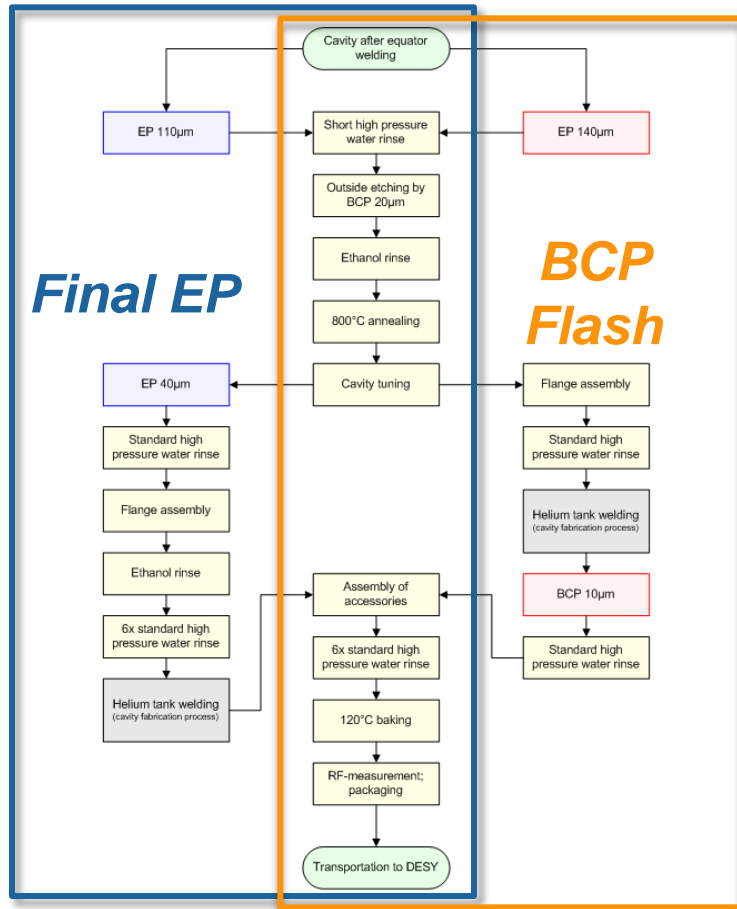
Supply of Nb/NbTi semi-finished products to E. Zanon



Cavities – Preparation & Reference Cavities

Two schemes for the final surface treatment:

- Final EP at Research Instr.
- BCP Flash at Zanon Inc.



At each company

4 dedicated Cav's for set-up of infrastructure

4 dedicated Cav's for qualification of infrastructure

Close supervision of
infrastructure set-up, processes,
procedures and handling

by DESY + INFN Milano

Specification w/o performance guarantee,
thus:

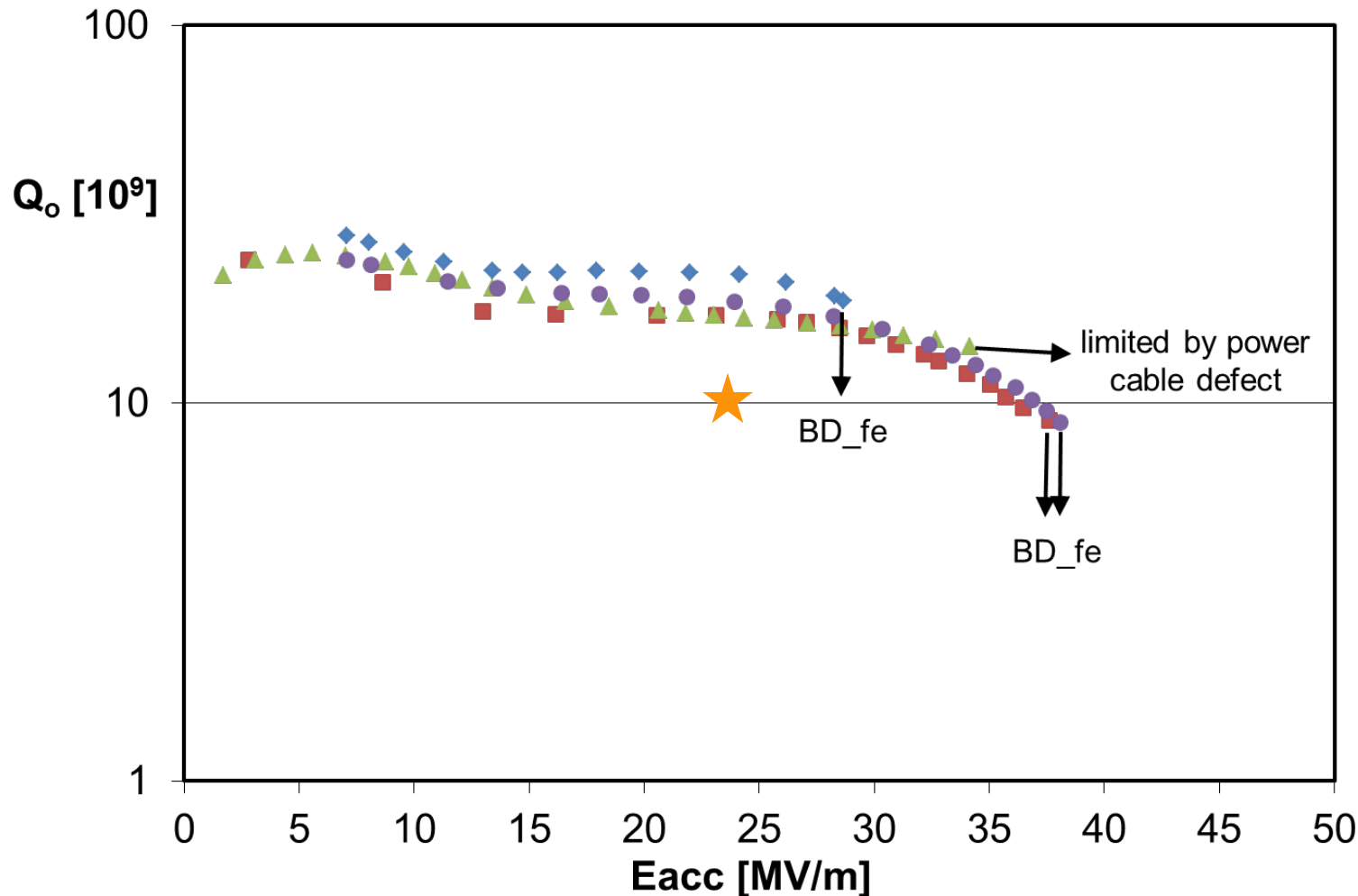
- the risk of unexpected low gradient or field emission is with DESY
- responsibility for re-treatment at DESY

Strategy of Reference Cavities (RCV)

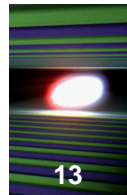
- Four reference cavities fabricated at each company
- First surface treatment and vertical acceptance test w/o He-tank at DESY (following the companies' preparation scheme: Final EP / BCP Flash)
- Stepwise qualification of surface treatment infrastructure at companies (after successful set-up of infrastructure with further dedicated cavities)

	Step 1	Step 2	Step 3	Step 4	Step 5
slow venting / slow pumping (incl. leak check + RGA)	X	X	X	X	X
disassembly of beam tube flange (short side), full HPR-cycle , drying, assembly of beam tube flange		X	X	X	X
disassembly of all flanges, assembly of flanges except of beam tube flange			X	X	X
Final 40µm EP (RI) / Final 10µm BCP (EZ), first HPR , ethanol rinse , 120° C bake				X	X
full surface treatment (incl. Main EP, outside etching, 800° C firing)					X

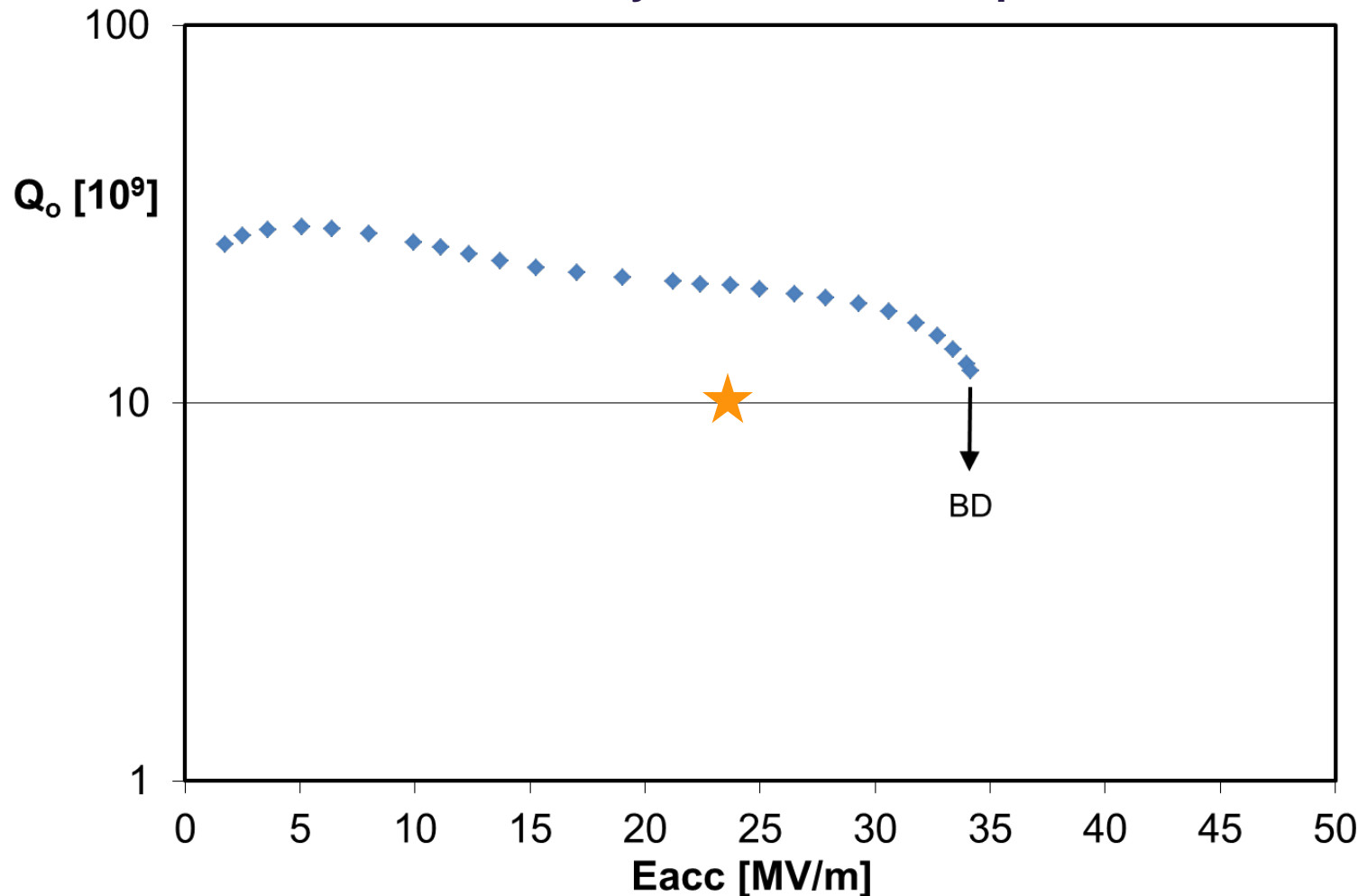
Acceptance test done with all four RI reference cavities $E_{\text{acc}} > 28 \text{ MV/m!}$

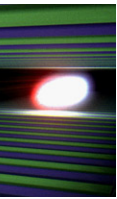


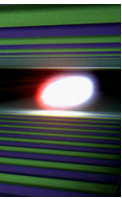
Status of Reference Cavities: EZ

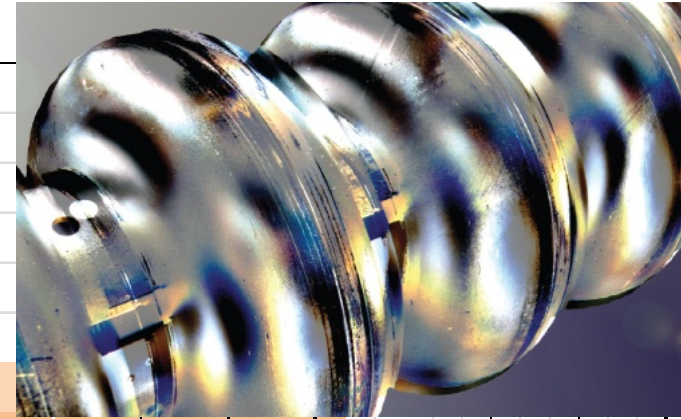
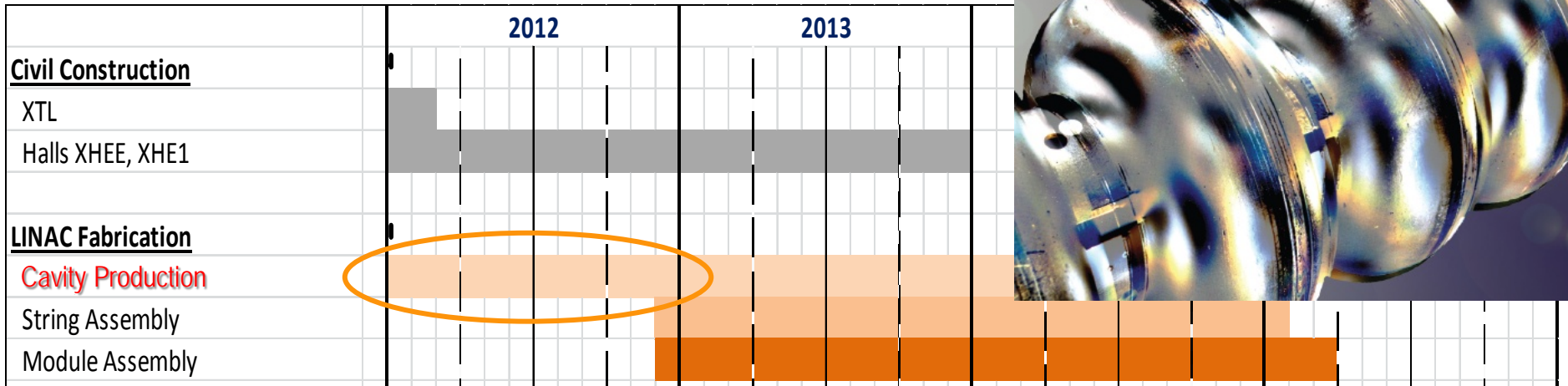
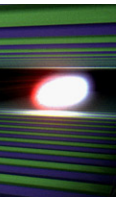


First cavity vertical acceptance test successful
Three cavities ready for vertical acceptance test









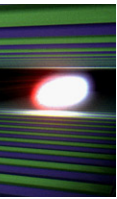
Research Instruments:

- pre-series cavities delayed by 6 weeks
- delivery of first cavities mid 8/2012
- challenge is the HPR station
- vendor schedules 4 cavs / week starting with first delivery
- the modified delivery plan leads to 42 series cavities expected until end of 2012

Zanon Inc.:

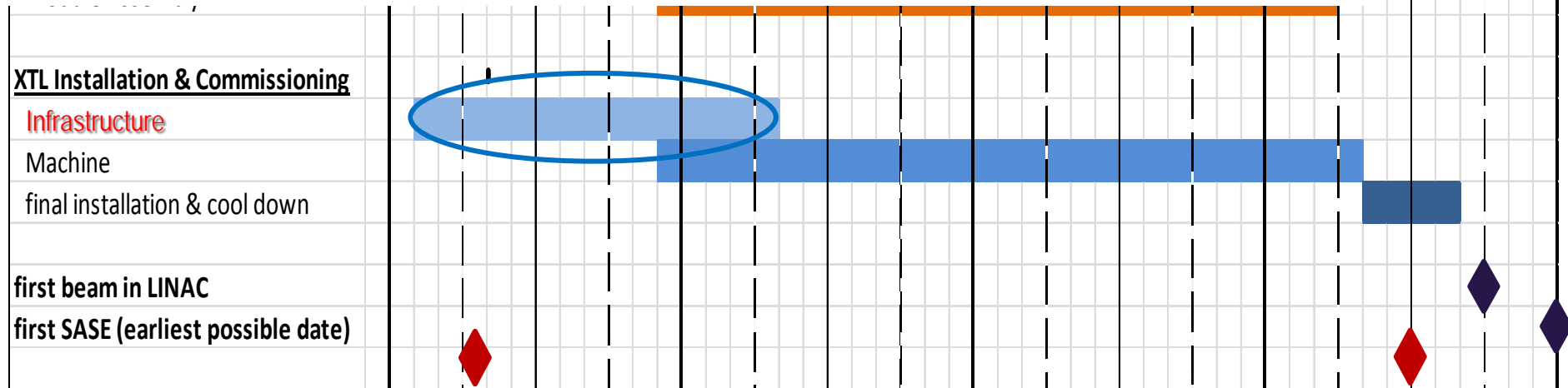
- pre-series cavities delayed by two months (mid 9/2012)
- challenge is the HPR station
- vendor schedule 3.5 cavs / week starting end of November
- we expect a total of 14 series cavities until end of 2012

Main Linac (XTL) Infrastructure



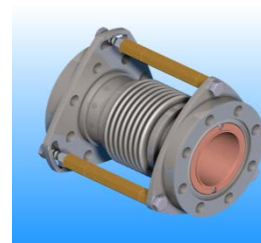
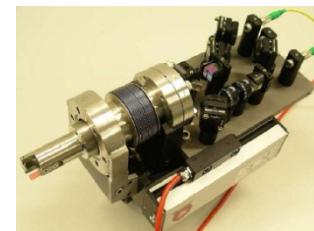
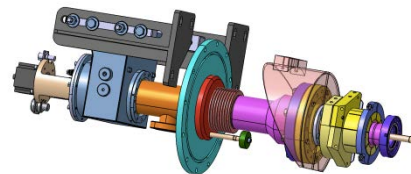
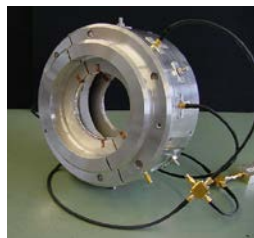
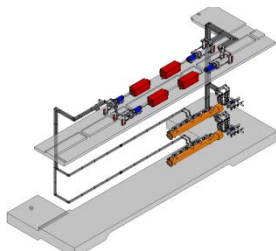
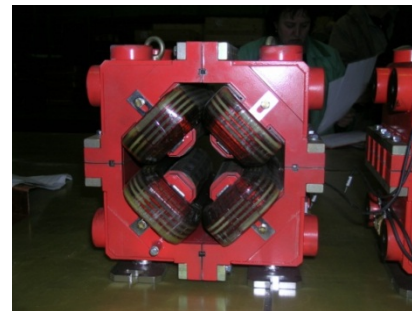
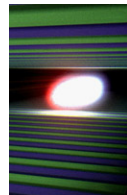
- Main Linac Tunnel Infrastructure installation started beginning of 3/2012
- Details to be reported by the Technical Coordinator
- Project Integration Time schedule (PIT) used to coordinate activities
- Initial infrastructure almost done (safety, light, ...)
- Some first unforeseen tasks (e.g. wobbling floor plates creating noise)
- Lot of work to be done until first accelerator components can be installed

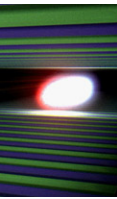
2015



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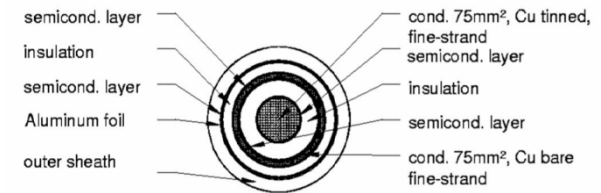
Accelerator components - *a non-exhaustive tour*





■ all major components ordered, i.e.

- klystrons
- modulators
- pulse transformers
- pulse cables
- connection modules



■ ordering of RF interlock components started

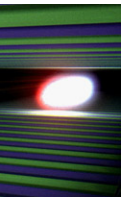
■ layout of RF racks

■ Long term test of connection module and HV cable with MBKs continued

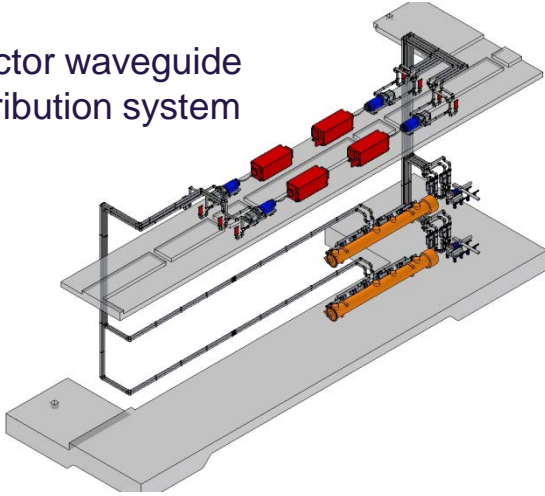
■ WATF procurement of components and installation in AMTF continued

■ Installation in KTF (klystron test facility) for further test continued

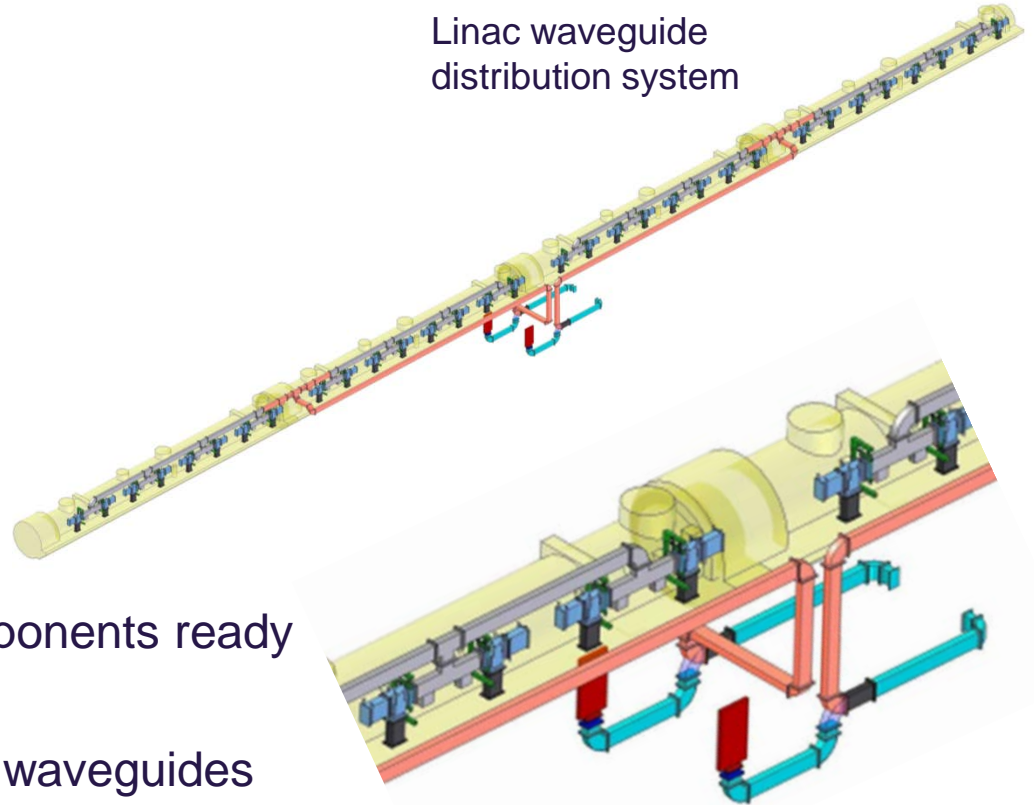
WP01 - Waveguide distribution



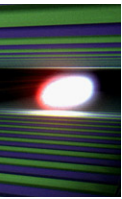
Injector waveguide distribution system



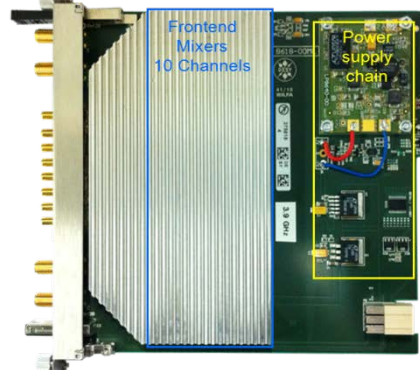
Linac waveguide distribution system



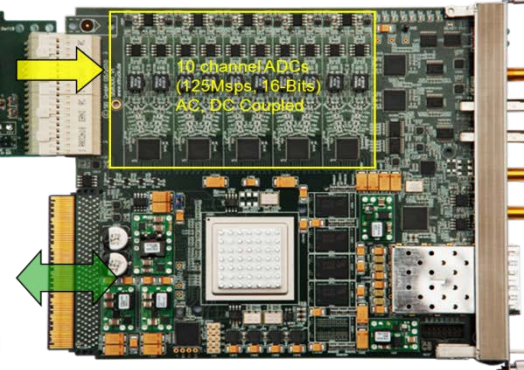
- specifications for waveguide components ready
- tendering will start soon
- large number of different types of waveguides
- interfaces and potential interferences to be further discussed



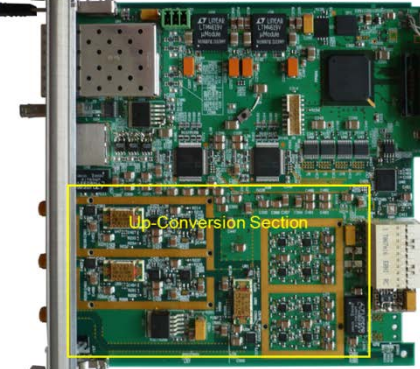
Down-converter



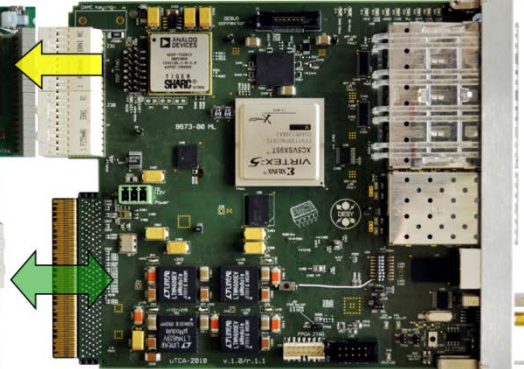
125 MSPS ADC



Vector modulator



Controller



Compact LO for crate



MTCA.4 Crate



■ Successful prototype tests of major components

- Down-converter
- 125 MSPS ADC
- Controller unit
- Vector modulator
- Piezo driver
- Drift calibration box
- Compact LO generation
- RF backplane

■ Several industry contracts launched

- Low noise power supplies
- CPU (together with WP28)
- LO generation carrier board

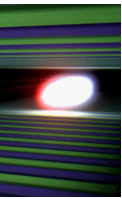
■ Final revision/preparation for production for most of the modules started

■ Software/firmware -> μ TCA ongoing

■ LLRF successfully tested at CMTB test stand and ACC1 (FLASH) and REGAE

■ Many new tools established during recent FLASH 9mA run!

WP03 - Cold Mass and Vacuum Vessel

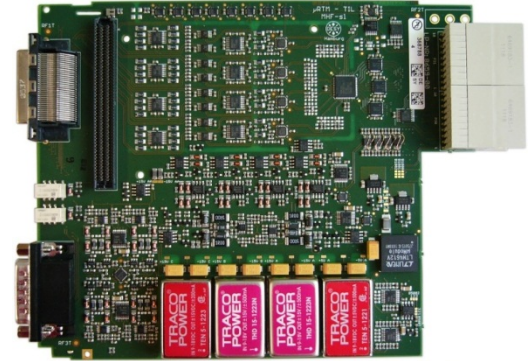
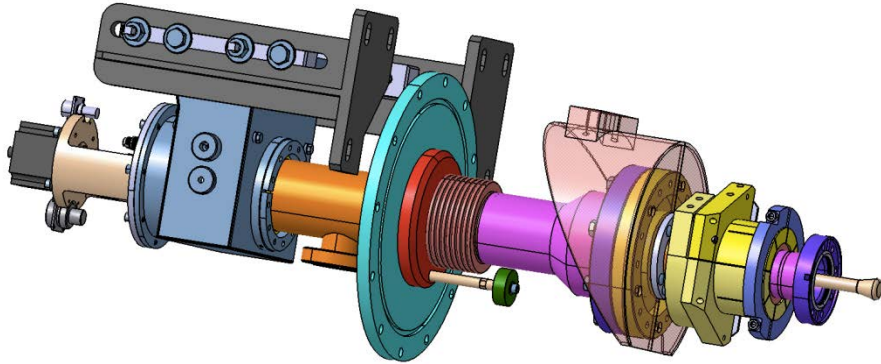
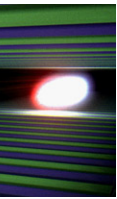


- 58 plus 25 cryostats and vacuum vessels ordered; fabrication on-going; sub-components ready for assembly.
- Production schedule uncritical. First units will arrive very soon (5/2012); storage at DESY and CEA foreseen.
- Remaining 20 cryostats: Call for tender (by DESY) prepared.

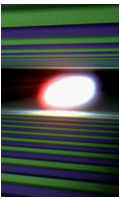


Institute of High Energy Physics
Chinese Academy of Sciences



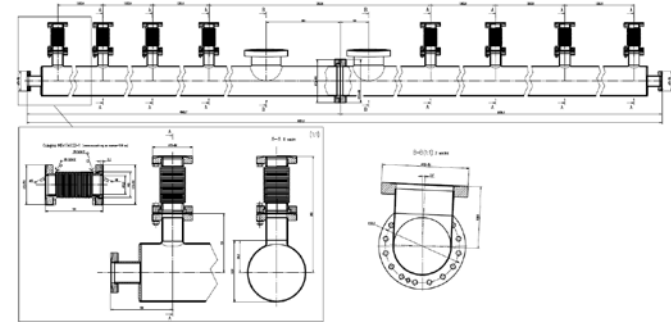


- The coupler production schedule became a real challenge and assumes that any further mistakes are to be avoided. Brazing and copper plating processes are challenging!
- **The start of the series production is still to be very critically addressed!!!**
- The pre-series modules get some extra attention by LAL & DESY.
- DESY has ordered 32 additional couplers in order to support the ramp-up and to make couplers available for the first modules.
- Coupler conditioning requires thorough preparation.
- DESY is responsible for the coupler interlock. Electronic board development is almost finished. Production is next.



■ Russian contribution (BINP)

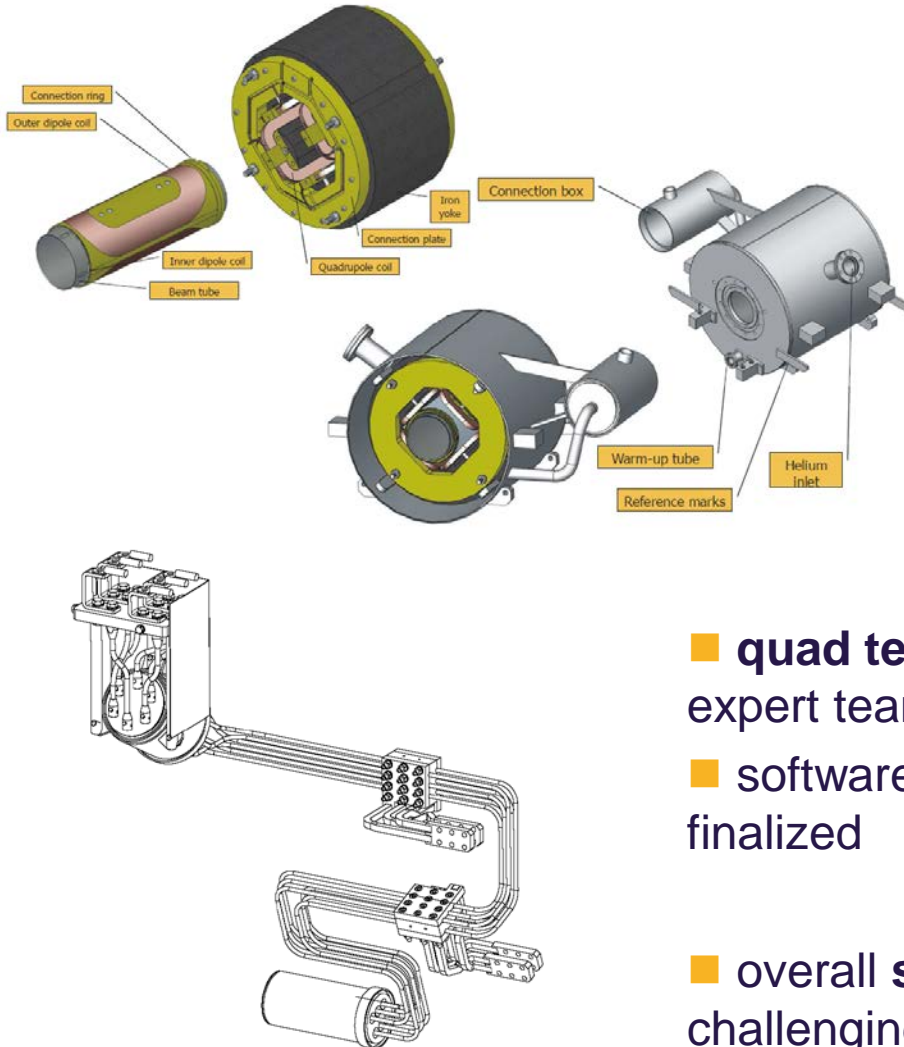
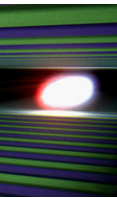
- first **cavity bellows** at DESY: QC ongoing
- first **coupler bellows** in April
- first **coupler line** in April
- series components delivery starts in June



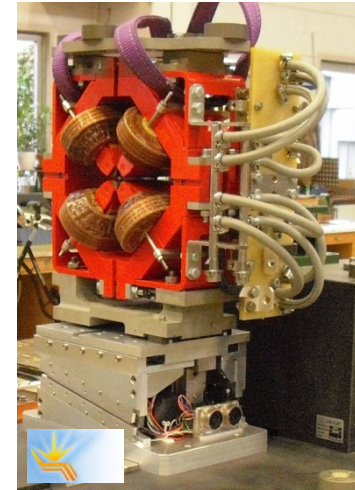
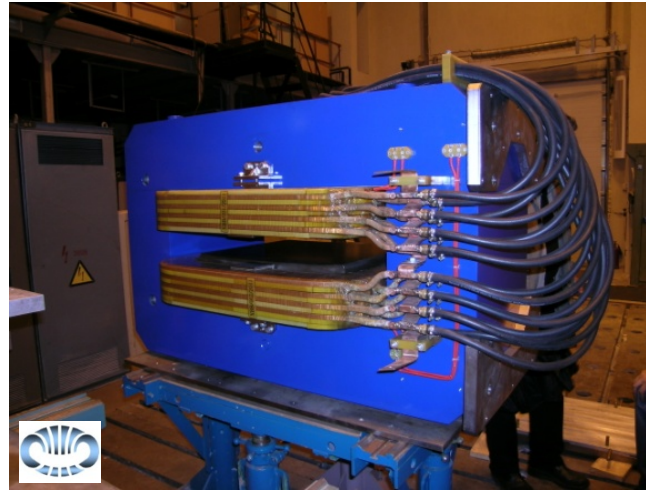
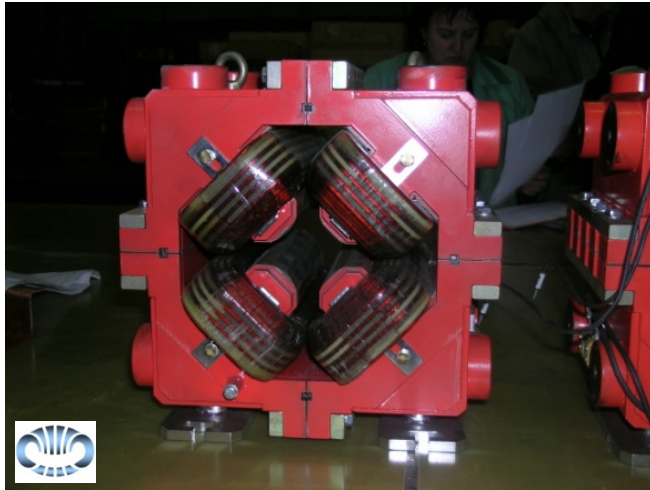
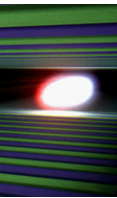
■ DESY contribution

- module **gate valves** for pre-series available: QC problem at manufacturer resolved
- **coupler pump line** CAD model completed incl. TSP power supply in April
- **isolating-vacuum**
 - scheme agreed with cryogenic group
 - pump carts available
 - first tests of large volume pump-down carts successfully completed
 - valves order being prepared

WP11 - Cold Magnets and Current Leads

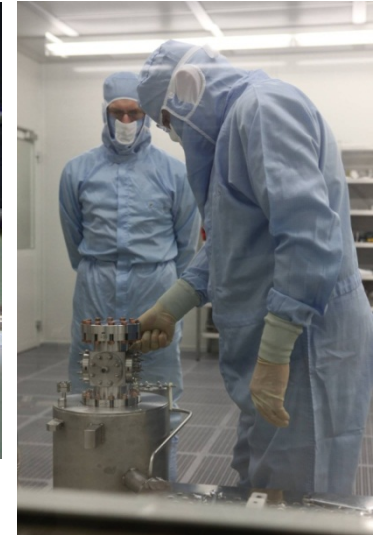
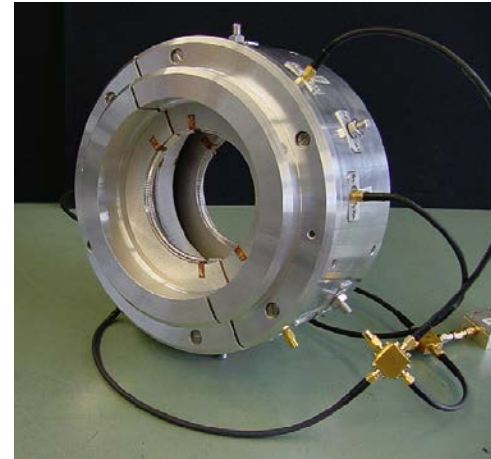
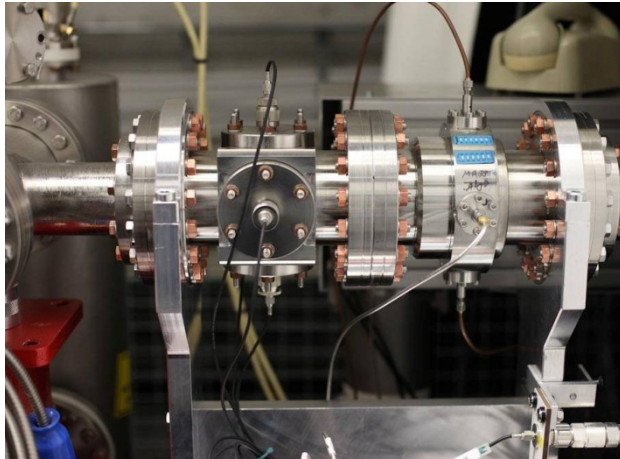
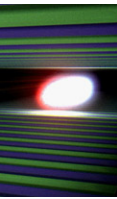


- **magnets itself** are a CIEMAT In-kind contribution; recent challenge: TUEV qualification of the vendor (ISO 3834-2)
- DESY supports activities and takes care of **beam tube copper plating** and **current leads**; both contracts were placed, series production to be started soon
- **quad testing** at DESY under preparation, i.e. expert team from IFJ established
- software for both DAQ and database to be finalized
- overall **schedule for first magnets** looks quite challenging!



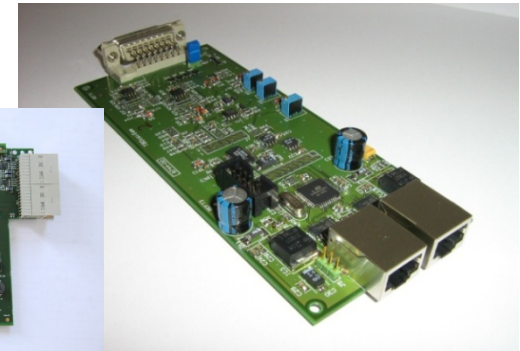
- Production of XQA magnets finished, measurement under way at Stockholm Univ.
- XBB production still on-going, measurement program set-up but extensive measurements take time.
- still more PRRs (production readiness reviews) to be finished
- coil production (XQI, XQF, XQH, XQE, XSC) on-going
- iron for the laminated yokes to be delivered now
- number of spare magnets and coils fixed and accepted
- refurbishing of the HERA QC coils is authorized

WP17 - all large number beam diagnostic elements



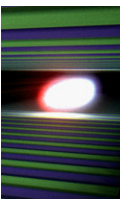
■ Development and production of beam diagnostic elements

- Beam Position Monitor Pick-Ups
- Beam Size Measurement System
- Beam Loss Monitor System
- Charge Monitors and Transmission Interlock
- Dark Current Monitor System
- Dosimetry System

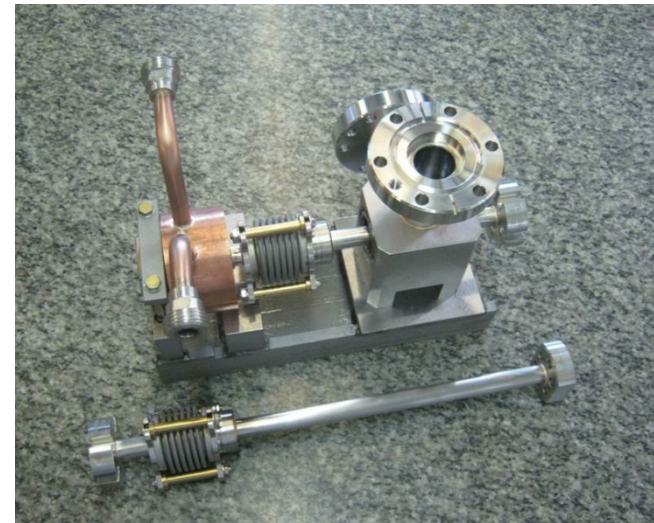
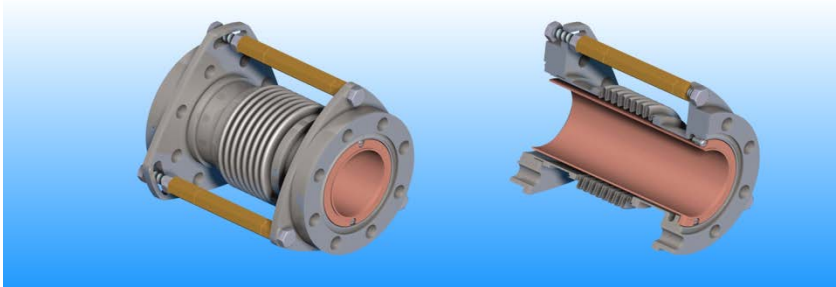


■ different status for the various components, i.e. prototypes / pre-series / first series

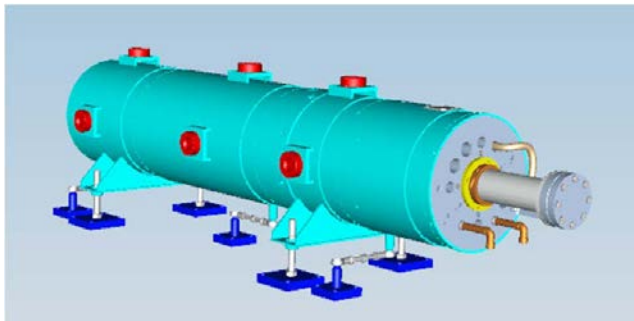
■ integration into different beam line sections on-going, installation schedule still to be established together with Technical Coordination



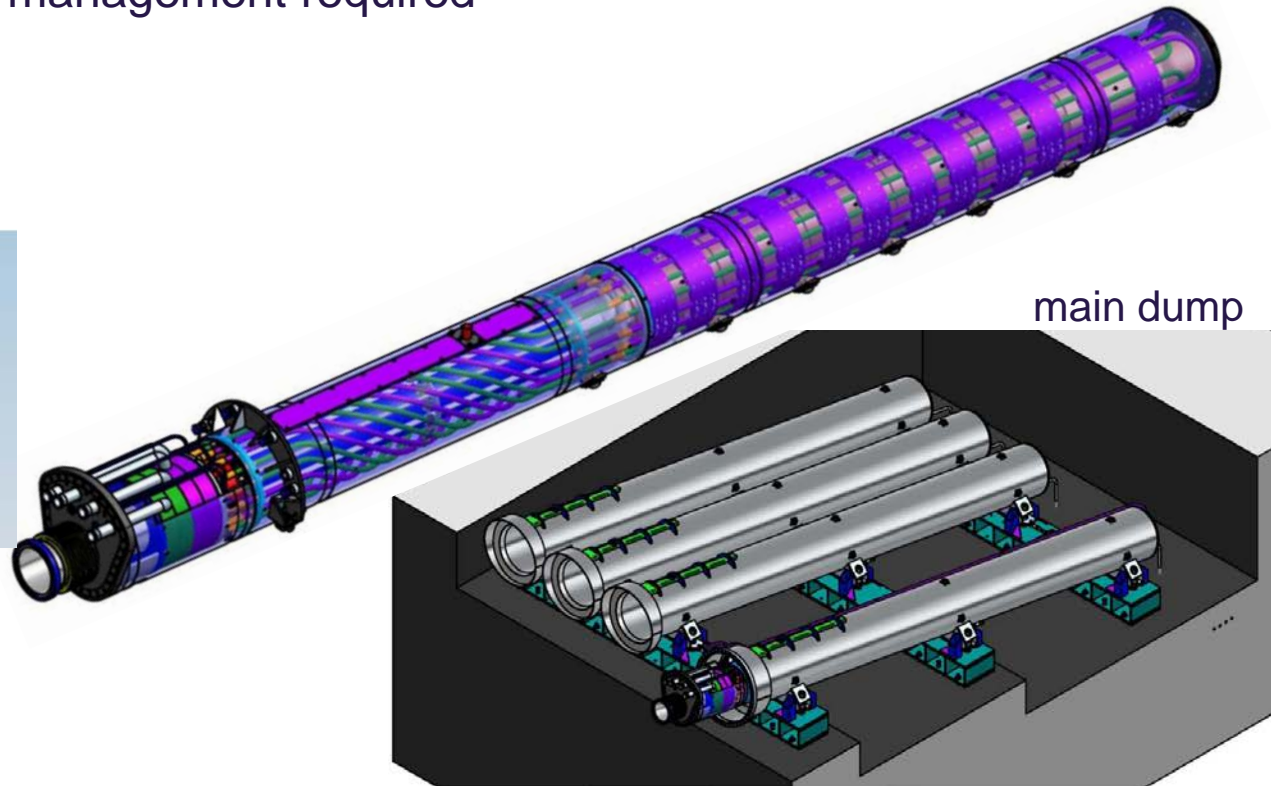
- detailed technical layout of the XFEL warm beam line vacuum sections shows progress but still much more work to be done
- design and manufacturing of vacuum chambers started
- ordering of commercially available components on-going
- UHV as well as particle cleaning where necessary to be prepared
- schedule installation of the components into the XFEL linac
- make available the required mobile vacuum equipment
- electronic components for the vacuum components including vacuum interlock



- IHEP is responsible for design and production while DESY takes care of the overall coordination and integration of all beam dumps.
- the project is challenging (material, quality plan, dump windows, installation)
- esp. main dumps have to be absolutely reliable
- excellent cooperation and management required
- schedule tight but viable

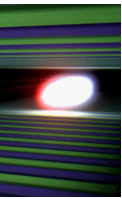


bunch compressor dump



main dump

Assembly and Test Infrastructures



- all collaboration partners were / are setting up major infrastructures for the production, assembly, and test of accelerator components
- utilities (mains, water cooling etc.) are required

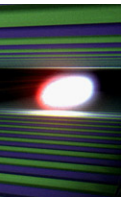




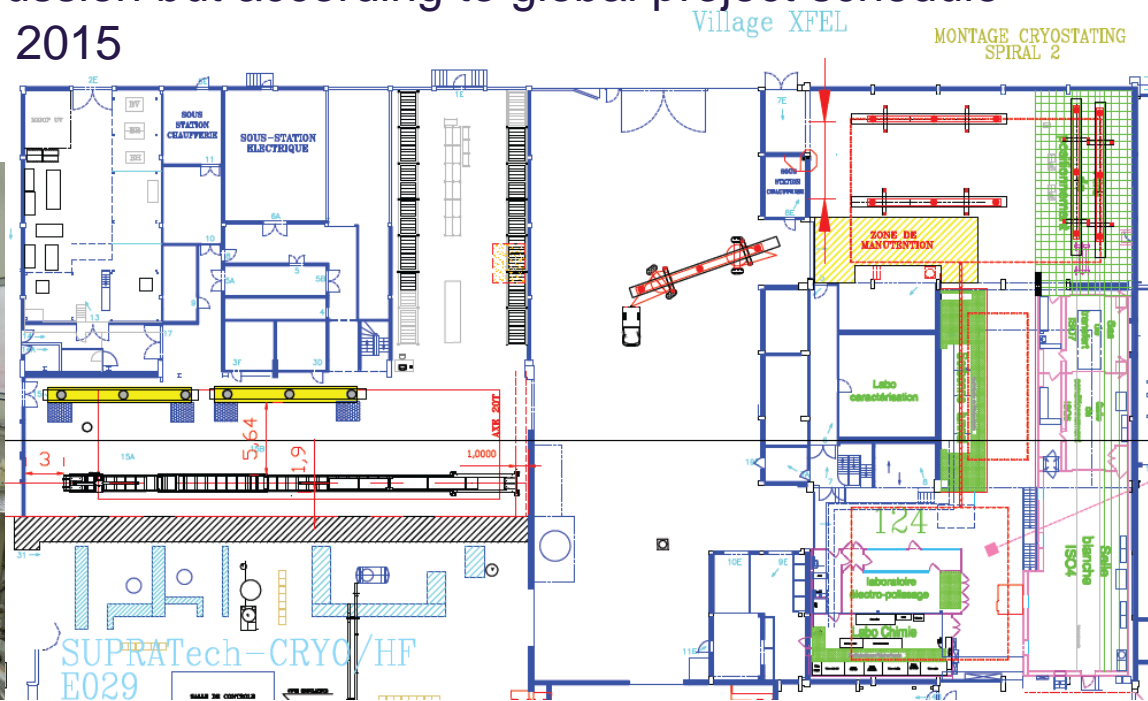
- Technology transfer wrt. cavity string and accelerator module assembly from DESY to CEA Saclay (IRFU) used large infrastructures at both institutes; extensive training phase
- SRF cavities needed for the training phase are prepared at DESY
- The refurbished DESY clean room will be used to pre-assemble the quadrupole packages with its' beam position monitors

- The cleanroom is also extensively used for WP04 Cavity activities: Reference cavities are surface treated and prepared for first RF tests

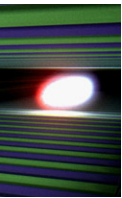
Saclay Infrastructure for String and Module Assembly



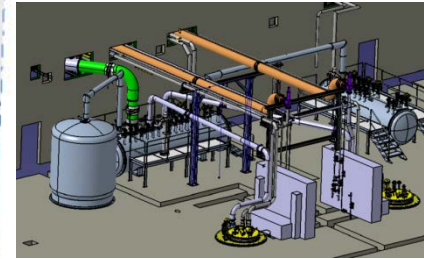
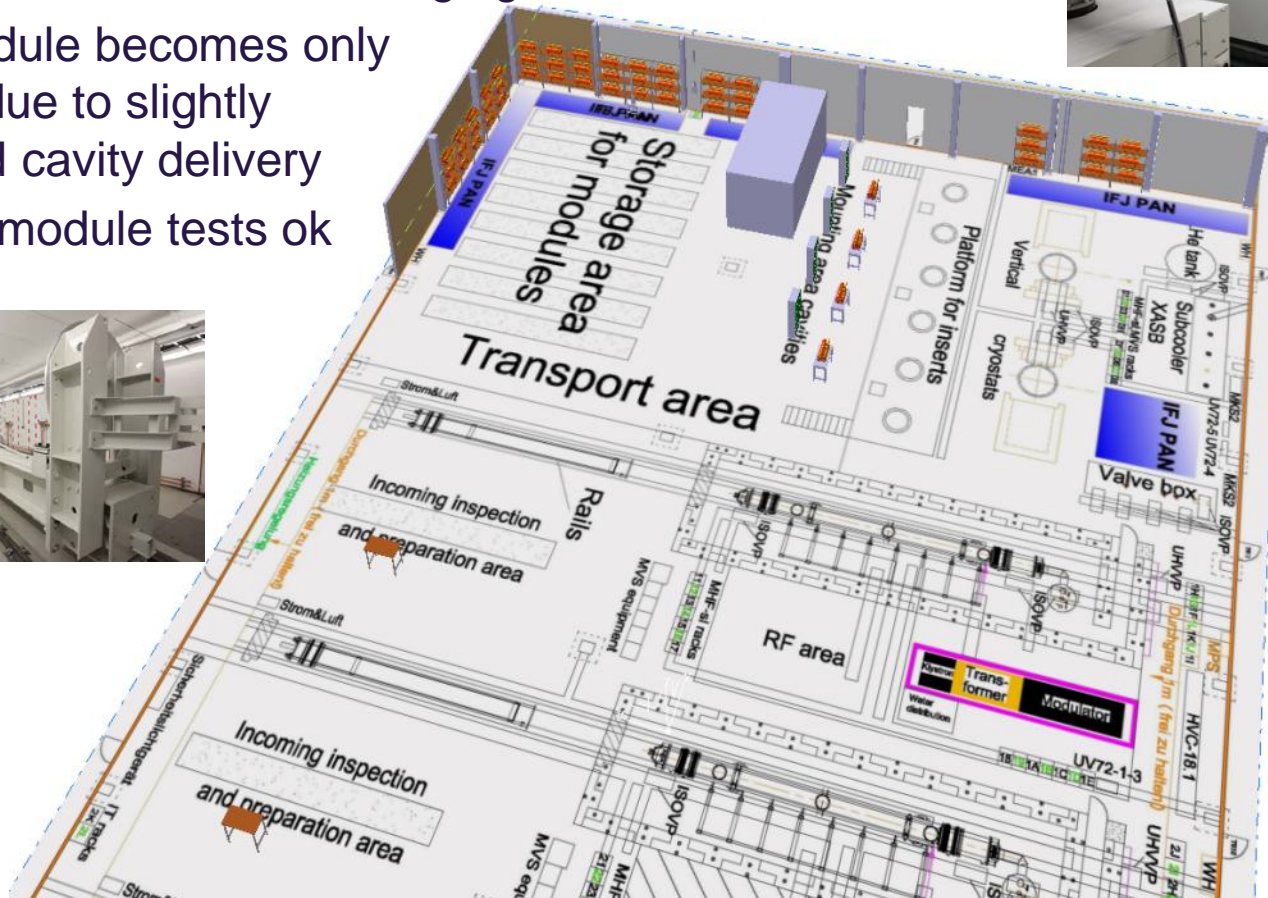
- Publicity and call for candidatures last summer
- Restricted CFT based on cryomodule assembly specifications
- Selection of industrial contractor finished; contracts to be placed now
- Pre-series assembly of three modules in 2012
- First series assembly scheduled for end of 2012
- Exact start date still under discussion but according to global project schedule module #100 expected for spring 2015



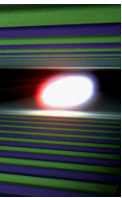
AMTF Test Stand Infrastructure



- Impressive AMTF infrastructure exists but some essentials still missing (e.g. vert. cryostats)
- schedule remains challenging until last minute
- schedule becomes only viable due to slightly delayed cavity delivery
- start module tests ok



Other contributions – again only examples



DESY In-kind Contributions

European
XFEL

WP15 - Bunch Compression



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DESY In-kind Contributions

European
XFEL

WP16 - Beam Optics



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DESY In-kind Contributions

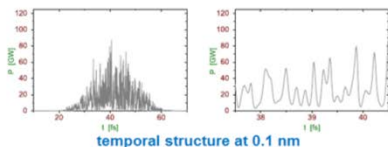
European
XFEL

WP21 – FEL Concepts



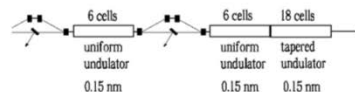
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- calculation of SASE parameters for XFEL operating points
- development of new FEL concepts (seeding, short pulses, ...)
- planning of commissioning strategies and operating scenarios for the multiple beam line facility



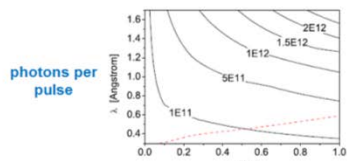
temporal structure at 0.1 nm

baseline gap tunable XFEL undulator SASE1, SASE2 (35 cells)



1 nC mode of operation

Concept for a self seeding scheme for hard x-rays



Base line performance of SASE 1



DESY In-kind Contributions

European
XFEL

WP35 – Radiation Safety



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DESY In-kind Contributions

European
XFEL

WP36 - General Safety



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DESY In-kind Contributions

European
XFEL

WP38 - Personal Safety

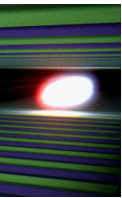


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- The main deliverables within this work package are:
 - Provision of the personnel interlock systems for magnet current operation in the XFEL accelerator tunnels and for all operation modes generating ionizing radiation in the accelerator tunnels, in the XHEXP1 experimental areas and at AMTF.
 - This includes
 - the design of the logical structure of the interlock system
 - The design and realization of the technical concept
 - the purchase of commercially available system components
 - the development, production, assembly and testing of electronic modules
 - the architecture and programming of the required interlock software
 - the planning of the cable and signal distribution system
 - the installation and the commissioning of the entire systems.



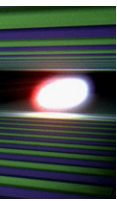
- many activities and lots of progress in other work packages too
- essential contributions from all teams



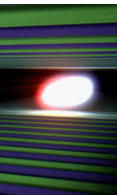
<p>Milestone Follow-Up, Scheduling, Infrastructure Installation, Quality Management <i>Markus Hüning, Riko Wich...</i></p> <p>SR 4b, Bldg 1b 09:00 - 11:00</p>	<p>Operation Envelope <i>Winfried Decking, Torsten...</i></p> <p>SR 4a, Bldg 1b 09:00 - 11:00</p>
<p>Control Software <i>christopher youngman, Kay...</i></p> <p>SR 4a, Bldg 1b 11:00 - 13:00</p>	<p>Vacuum Systems <i>Martin Dommach, Sven Led...</i></p> <p>SR 4b, Bldg 1b 11:00 - 13:00</p>

- discussions within working groups will reflect the actual status of all WPs
- plans, collaborations, achievements, challenges, risks, schedule

<p>Machine Protection System / Personnel Interlock <i>Martin Staack, Harald Sinn</i></p> <p>SR 4a, Bldg 1b 14:00 - 16:00</p>	<p>Cold Linac WPs and WP10: Data Exchange and Handling <i>Detlef Reschke, Elmar Vog...</i></p> <p>SR 4a, Bldg 1b 14:00 - 16:00</p>
<p>Timing, Electronics & FPGA development <i>Holger Schlarb, Patrick Ges...</i></p> <p>SR 4a, Bldg 1b 16:00 - 18:00</p>	<p>Cold Linac WPs and WP10: Global Schedule 'from Cavity to Tested Module' <i>Elmar Vogel, Detlef Resch...</i></p> <p>SR 4a, Bldg 1b 16:00 - 18:00</p>

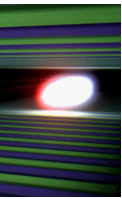


Project Risk Register



ID	Area of Project / Work Package	Risk Description	Risk Type	Possible Consequences	Impact	Probability	Severity of Risk	Date of Risk Identification	Date when Risk Consequences Start Affecting the Project	Risk Mitigation Mechanisms
05.03	WP-05: Power coupler	interlock development behind schedule	schedule		severe	low		26.09.2007		schedule aligned with overall project schedule; development still ongoing thus we should keep it; the probability seems low, but if there is a delay then it will be a general delay for the commissioning 'low' and 'severe'
05.04	WP-05: Power coupler	conditioning time may be too long for series production of modules	schedule		moderate	medium	pale	26.09.2007		according to experience not very likely but it cannot be excluded that some couplers need longer RF conditioning time; if so it becomes a delay for the module assembly and all other downstream tasks; due to some parallel use of a second RF station it can be handled, nevertheless we should set it to medium & moderate medium and moderate
05.08 NEW	WP-05: Power coupler	LAL RF power station is not working reliable enough	schedule	no coupler conditiong	moderate	medium	pale	26.03.2012	Fall 2012	sufficient emphasis by LAL
05.09 NEW	WP-05: Power coupler	joining and copper plating technique not sufficiently established	technical	no couplers	severe	high	red	26.03.2012	Summer 2012	strong cooperation between LAL as contractor and Thales as vendor
05.10 NEW	WP-05: Power coupler	coupler production behind schedule	schedule	no couplers	severe	high	red	26.03.2012	Summer 2012	strong cooperation between LAL as contractor and Thales as vendor
08.01 NEW	WP-06: HOM	BLAs behind schedule	schedule	no BLAs	severe	low		26.03.2012	Spring 2013	to be solved by IKC
07.02	WP-07: Frequency tuner	Module long-term storage under defined and dry conditions	technical	Malfunction of tuner drives	severe	low		05.02.2008	Machine commissioning	Development of proper storage for accelerator modules still valid, methode developed i.e. known; in addition quick installation of 12 module string planned thus iso vac started soon after installation; but risk remains, set it to low low
08.02 NEW	WP-08: Cold Vacuum	not well defined emergency operation of vacuum system after power cuts	technical	delay in commissioning	severe	low		26.03.2012	2015	becomes a risk during commissioning and has to be adressed before due to its impact
09.01	WP-09: Strings	Experience transfer to CEA and from CEA to Industry	schedule		moderate	medium	pale	26.09.2007		see also WP.03.03; remains some risk until the first modules are assembled and tested moderate medium
09.02	WP-09: Strings	Timing at Saclay / time slip on Spiral 2 (Cleanroom availability)	schedule	Infrastructure problems at the proposed in kind infrastructure can lead	moderate	medium	pale			infrastructure well set-up but prject priorities need to be well defined, otherwise resources and thus schedule risk; set it to moderate medium until first mdoules are assembled and work is well established (beg. 2013) moderate medium

- with each Progress Review we collect / update issue and risk lists based on the WPL's information and PM's judgement
- we see technical, organizational, schedule and budget issues



WP internal

- technical risks
- organizational risks

cross WP
OR
global project risk ?

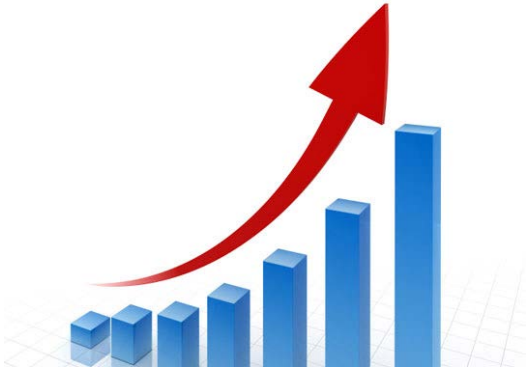
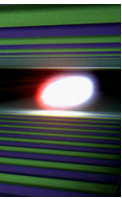


- technical risks
- organizational risks
- schedule
- budget

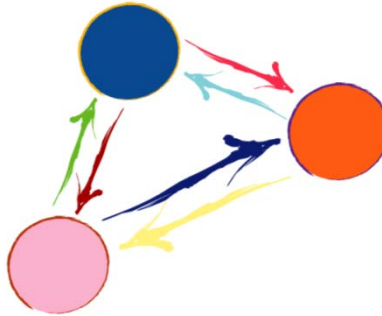


- **schedule risks** easily translate into **budget risks** for either / or / and the own contribution, other IKC partners, European XFEL company
- just salaries: beginning of 2015 the project has approx. 500 co-workers which amounts to approx. 3 M€ per month
- **installation phase ends with successful commissioning** thus a delay creates a cost overrun even if the bitter pill of own IKC over-costs is swallowed
- thus it might make sense to use additional resources to keep the schedule
- more important: in case of delays never give up working on recovery strategies
- sufficient flexibility is expected to account for delays of some few weeks out of the still 167 weeks to go until tunnel closing; **adjust resources if required!**

The way to common success



progress



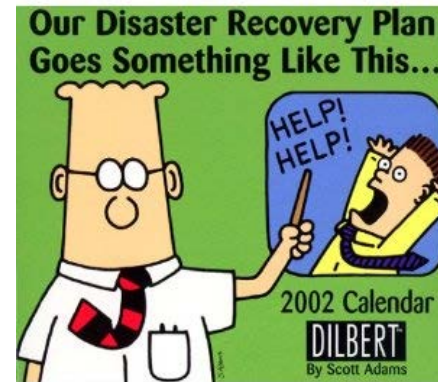
interaction



collaboration



disputes



recovery plans