



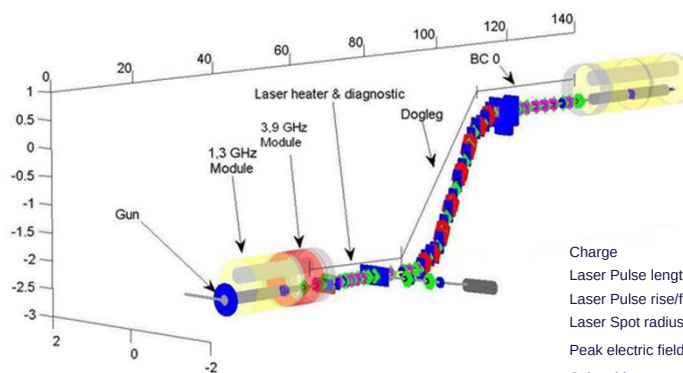
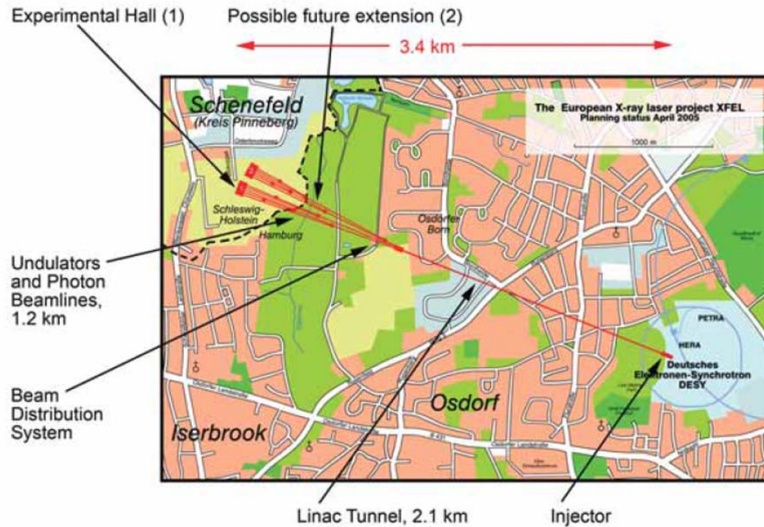
XFEL Injektor – Eine Einführung

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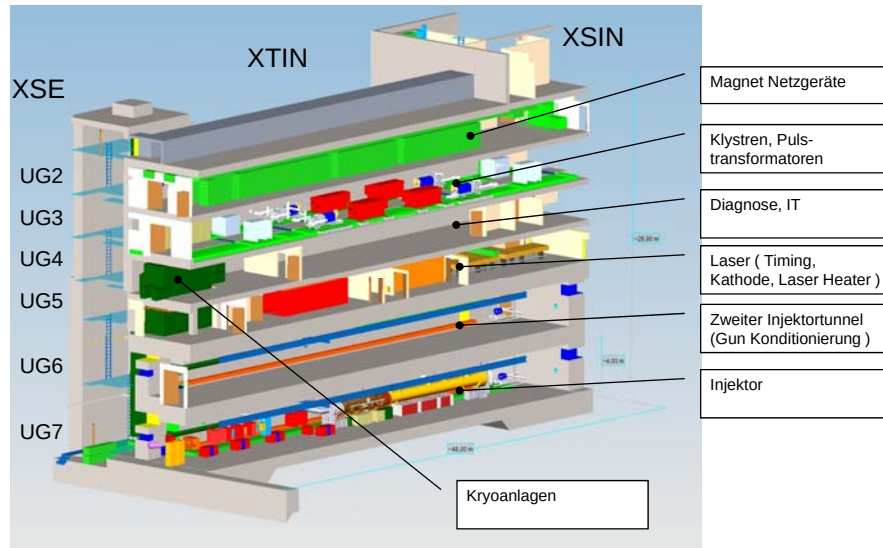
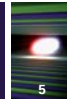
unter Verwendung zahlreicher Folien von geschätzten Kollegen



- Das Injektorgebäude (Wo ist Was ?)
- Erstes Ziel erreicht: Gun / HF Test im Dezember
- Kalte Module
- Diagnose
- Laser Heater
- Injektordump
- XSE – Übergang zum Haupttunnel
- Aktuelle Aktivitäten



Charge	1 nC
Laser Pulse length (total)	20 ps
Laser Pulse rise/fall time	2 ps
Laser Spot radius	1.1 nm
Peak electric field on the cathode	60 MV/m
Solenoid centre position (w.r.t. cathode)	0.41 m
Solenoid peak field	0.19 T
Final energy:	120 MeV



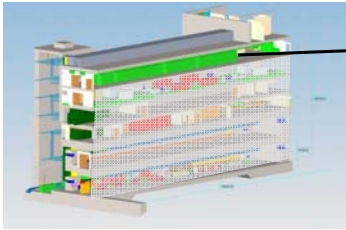
Vorbereitungen für den Gun/HF Test im Dezember '13

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Power Supplies



- Power Supplies for the 2 Solenoids are installed and running in UG2
- Controlled via Software from Accelerator Control room




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Successful commissioning of the 1.3GHz modulator from Ampegon in Oct. '13






Modulator

Pulse transformer

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Pulse transformers and connection modul



9

- Der Pulstransformator erzeugt aus den 10kV Pulsen des Modulators die 120kV für das Klystron



Pulstransformator von ABB



Verbindungsmodul von
BINP / Novosibirsk

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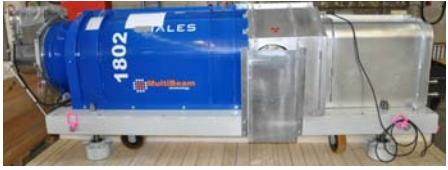
10 MW klystrons for the 1.3GHz module and the gun



10

Parameter

■ Frequenz:	1.3GHz
■ Kathodenspannung:	< 120 kV
■ Strom:	< 140 A
■ Max. HF Peak Power:	10MW
■ HF Pulsdauer:	1.5ms
■ Repetition Rate:	10Hz
■ Mittlere HF Leistung:	150kW
■ Effizienz:	63%
■ Solenoid Leistung:	< 5.5kW
■ Länge:	2.5m



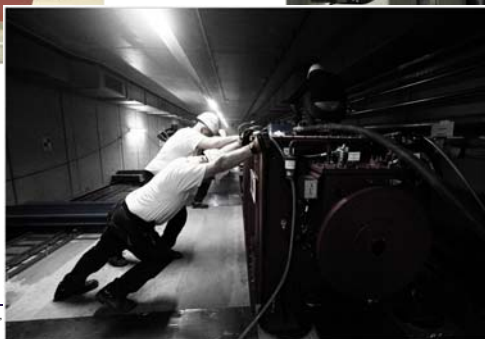
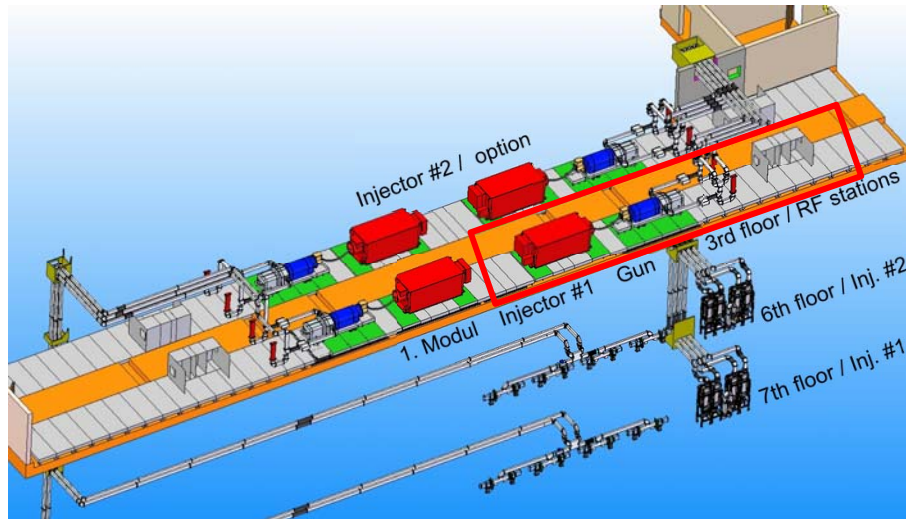
Thales Klystron mit Verbindungsmodul



Thoshiba Klystron

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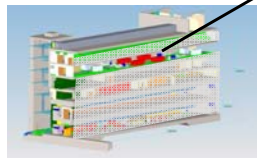






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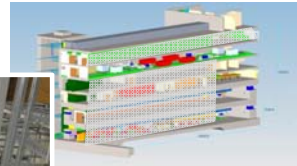
- 2 pulse transformers, one Toshiba and one Thales klystron are installed for gun and 1.3 GHz ACC-1Module
- First RF Pulses on Oct. 30th (on load)
- No problems observed during Gun Test



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15



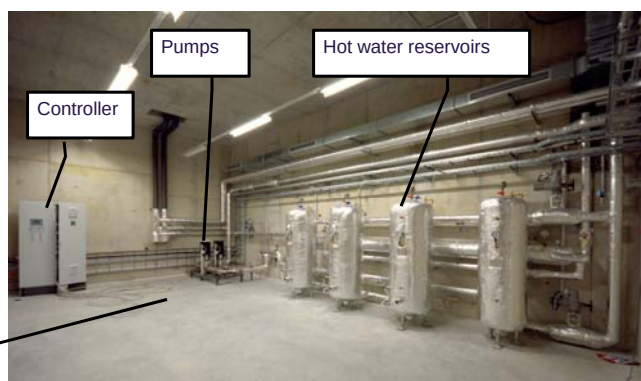
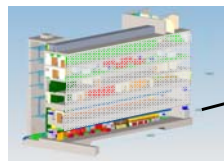
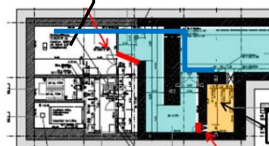
- Power from one klystron is distributed over four air filled waveguides and recombined at the gun, 0.5 bar overpressure
- The installation and commissioning of the waveguide system is done in collaboration from TU-Sofia, IHEP and DESY

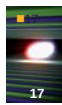


16

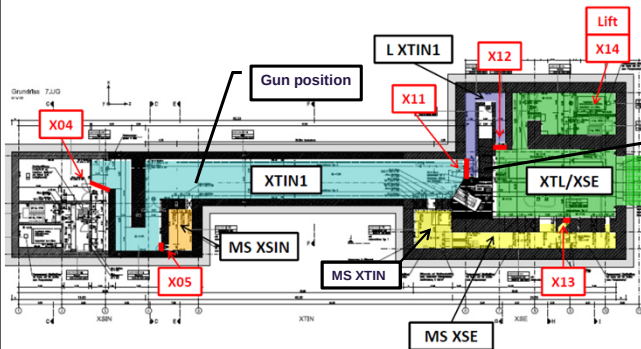
- The gun temperature stabilization is installed and running in UG7 (~ 30m from gun)

Gun
cooling





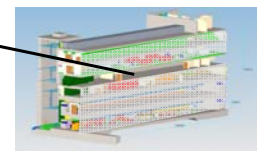
- The interlock systems for XTIN1, the Media shaft XSIN and the Labyrinth XTIN1 are ready
- The access to Media shaft XTIN will be blocked for the gun test
- 90 to. movable concrete door is in place



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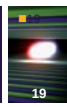
- The machine interlock system is placed in UG4 and monitors signals from the cooling water, temperature sensors, photo multipliers and charge detectors.
- The time delay from failure to interlock signal is in the order of 10 μ sec.
- Events from “reflected power” are handled by the RF-electronics



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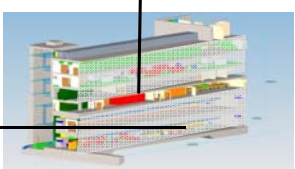


Master Oscillator, Timing – UG5/ LLRF UG7



19

- Master oscillator and timing unit are installed in UG5
- μ TCA LLRF electronics is installed near the gun

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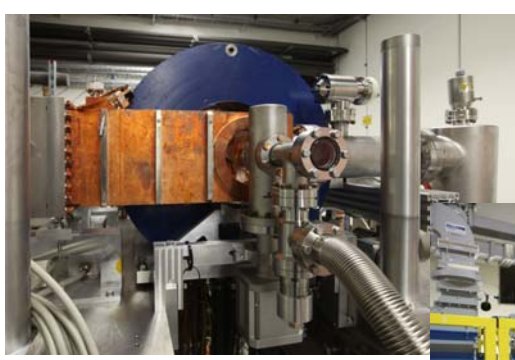




Gun Stand – UG7



20






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Gun 4.3 conditioning – DESY Zeuthen

21

- Parameters reached during conditioning:

Max. power	6.5 MW	650 $\mu\text{sec}/10\text{ Hz}$
Stable operation	6.5 MW	200 $\mu\text{sec}/10\text{ Hz}$
Stable oper., long pulses	5.8MW	650 $\mu\text{sec}/10\text{ Hz}$
Dark current	80 μA	6.6 MW
Max. e- momentum	$\sim 6.5\text{ MeV}/c$	6.5 MW
Transv. norm. rms Emittance	1.4 μm	500 pC
rms Momentum spread	$\sim 80\text{ keV}/c$	700 pC

- comments:
 - The Thales coupler window has been preconditioned up to 6.0 MW with long pulses. Due to severe problems to receive new, acceptable windows it was decided to limit the power during conditioning to this value
 - Conditioning was done with all possible Solenoid currents
 - The used cathode laser produced a short gaussian pulse, therefore the measured emittance is not comparable to former values reached with a flat top pulse

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Results of the gun test

22

- Tests of technical systems
- Gain valuable experiences with
 - RF-system
 - Gun cooling
 - LLRF (uTCA)
 - Master oscillator
 - Waveguide system
 - Interlock system

Reached power levels :

(limited by light events at the window)

◆ Dec '14

■ specification

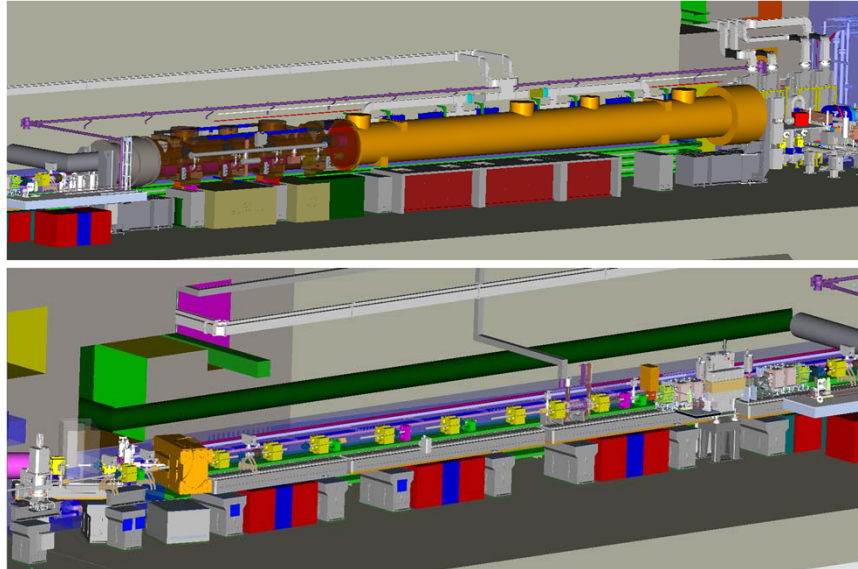
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Weitere Installationen bis Mitte 2014

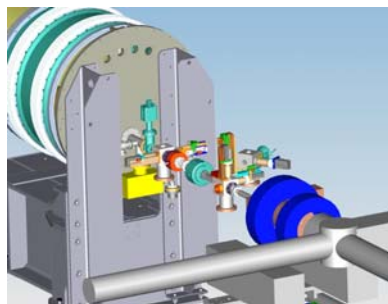
***Geplant ist der Aufbau der kompletten Beamline, bis
auf die Beschleuniger Module***

Injector tunnel (Apr. 2013)





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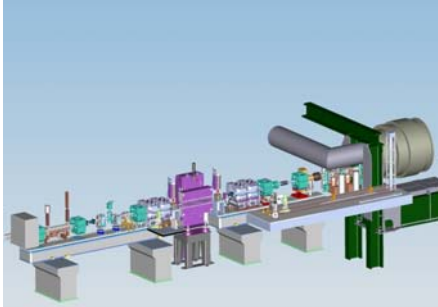


- Ladung
 - Toroid
 - Dunkelstrommonitor
 - Faraday Cup
 - Integrated Faraday Cup
- Position
 - Knopfmonitor im Diagnosekreuz
- Strahlform
 - Schirme
- Energie
 - Spektrometer Magnet

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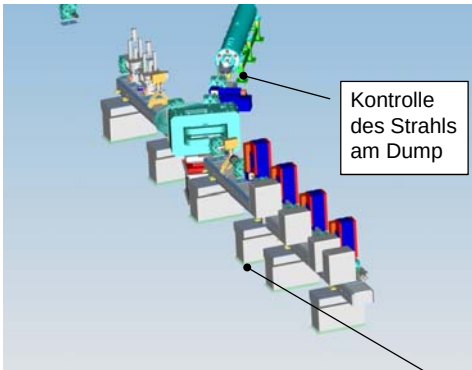
27



- Ladung
 - Toroid:
 - DCM:
- Position
 - BPMC/R:
 - BPMA:
 - BPFM:
- Strahlform
 - OTRL:
 - Mover + Screen:
 - Chamber: to be delivered by Uni Upsala
 - Verlustmonitore:
 - BLM:



28



- Ladung
 - Toroid:
- Position
 - BPMA:
 - BPMD:
- Strahlform
 - OTRC:
 - OTRD:
- Losses
 - Verlustmonitore
 - Strahlhalomonitor (Dump) ?

Kicker erlauben die Auswahl einzelner Bunche zur Diagnose



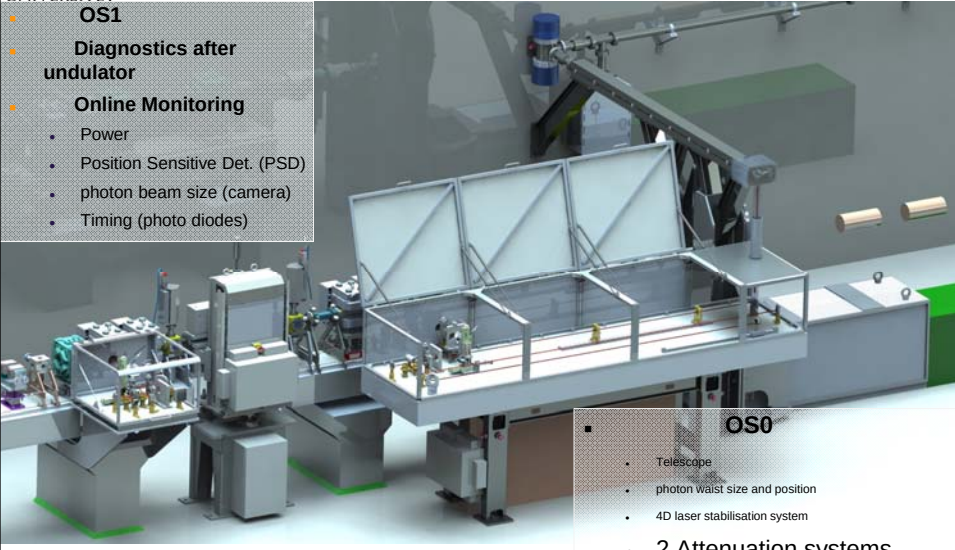
UPPSALA
UNIVERSITET

If the beam is too good : Laser Heater

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OS1

- **Diagnostics after undulator**
- **Online Monitoring**
 - Power
 - Position Sensitive Det. (PSD)
 - photon beam size (camera)
 - Timing (photo diodes)



OS0

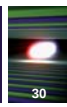
- Telescope
- photon waist size and position
- 4D laser stabilisation system
- 2 Attenuation systems

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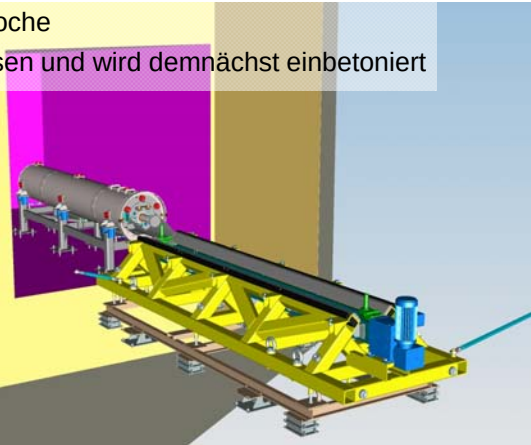





Injector Dump – for independend operation

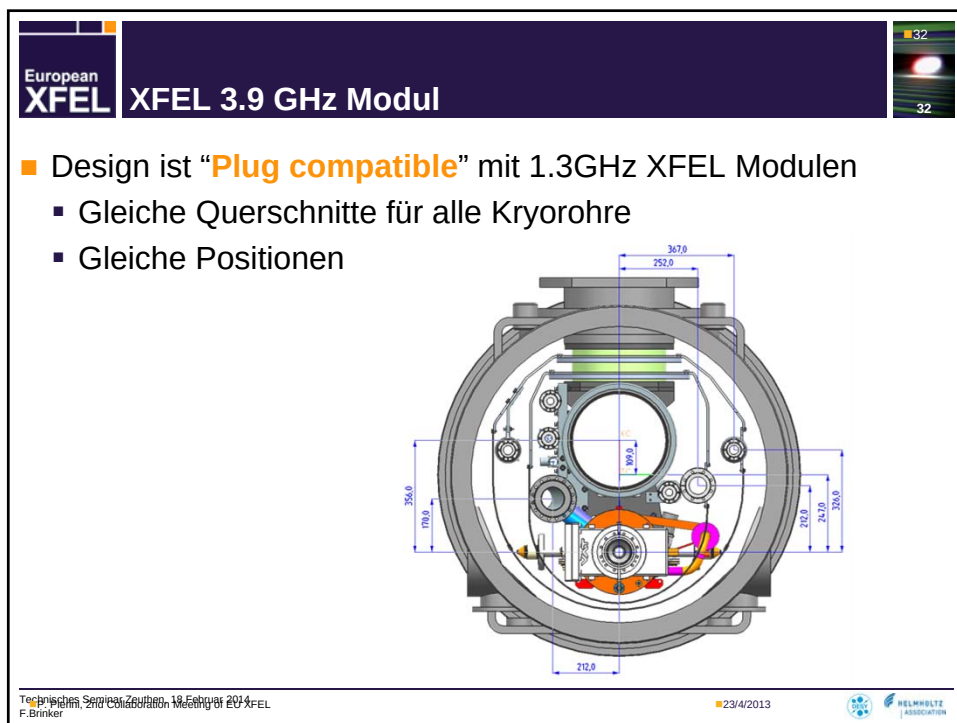
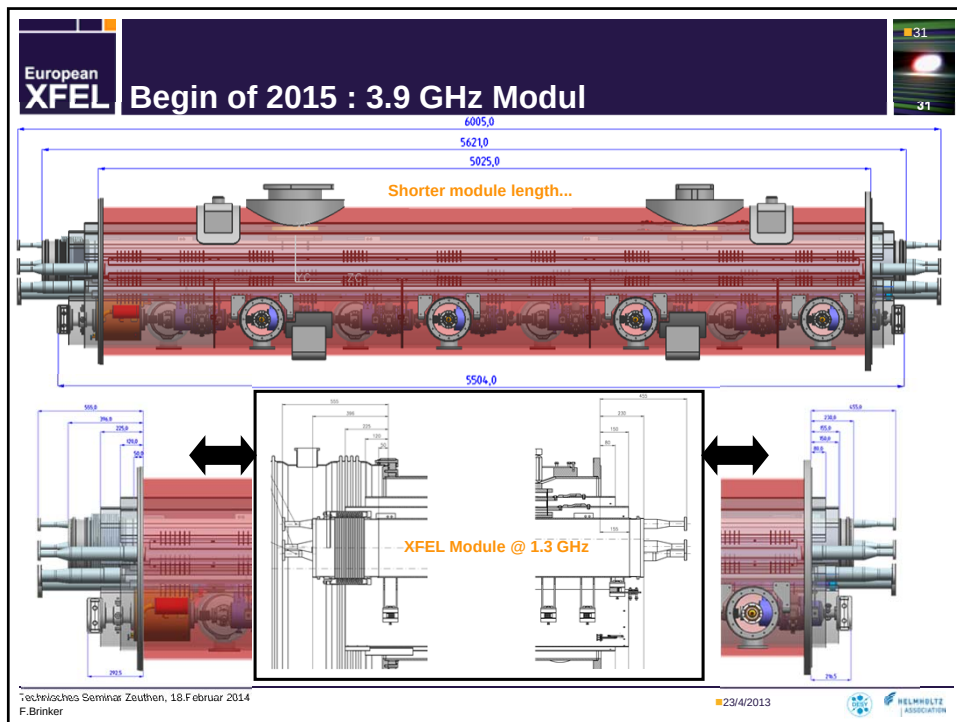


- Dump Design fertig
- Fertigung läuft
- Das Montagefahrzeug war Ende 2013 fertig
- Test mit Dummy in dieser Woche
- Die Dumphülle ist eingemessen und wird demnächst einbetoniert

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33

XSE – transition to main linac

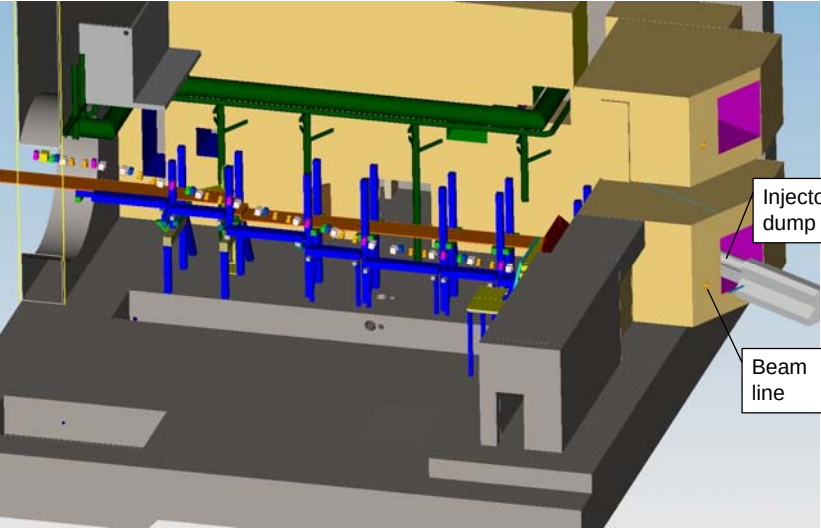
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 HELMHOLTZ
ASSOCIATION

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XFEL

XSE

34

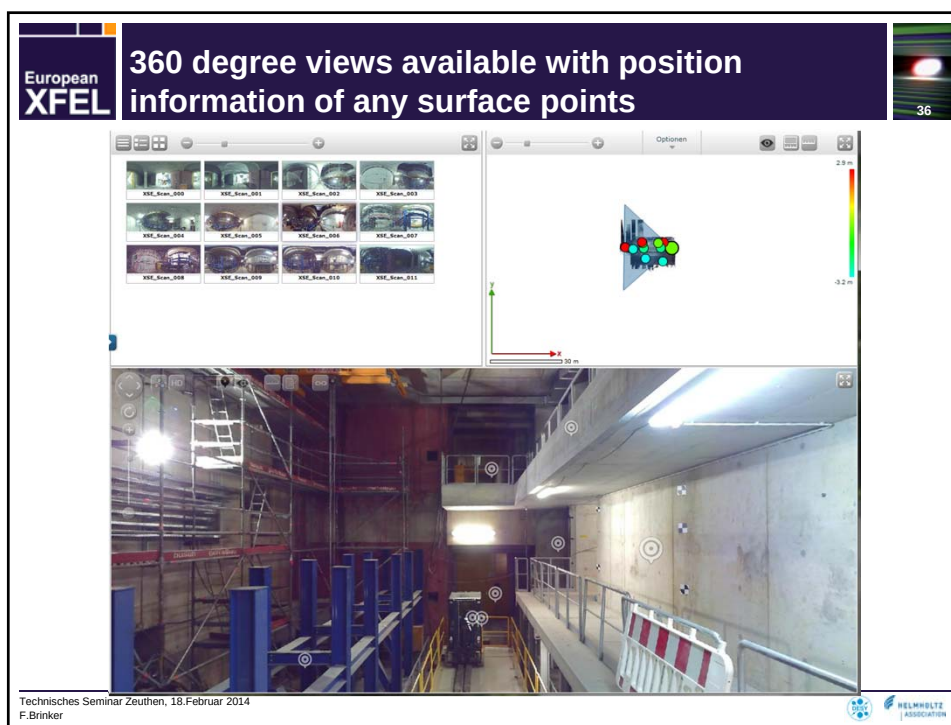
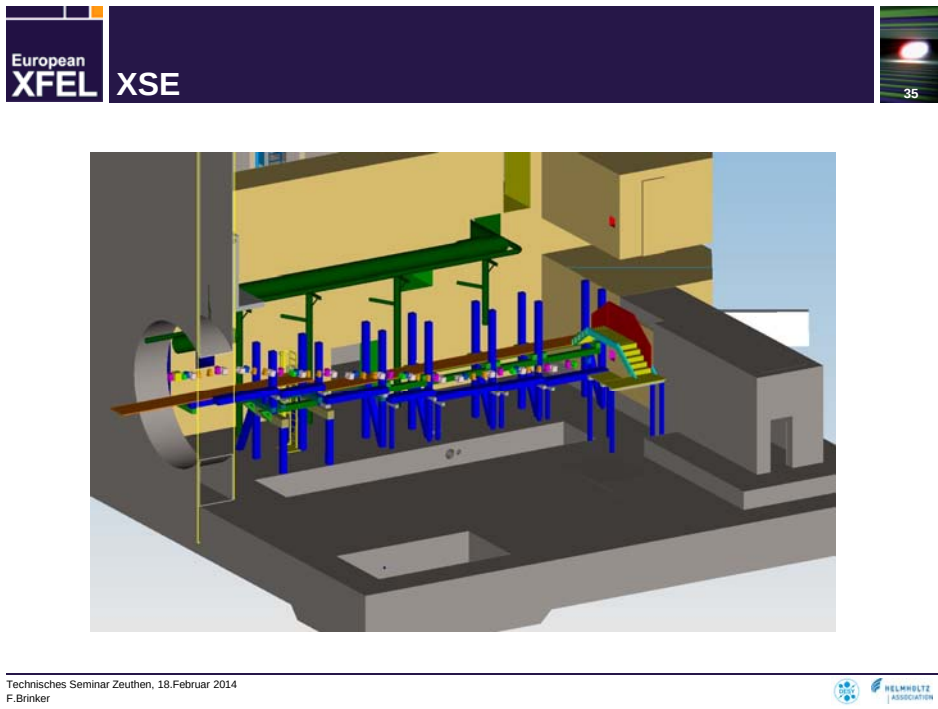


Injector dump

Beam line

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ASSOCIATION

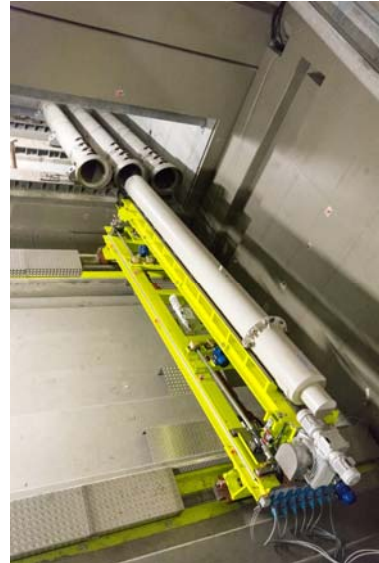


Some pictures from recent activitys

Dump exchange vehicle XS1 installed and tested



- In case of a failure the dump can be exchanged remotely and stored in an adjacent container
- Designed for up to 300 kW average power
- 3.6m Graphite in a copper enclosure



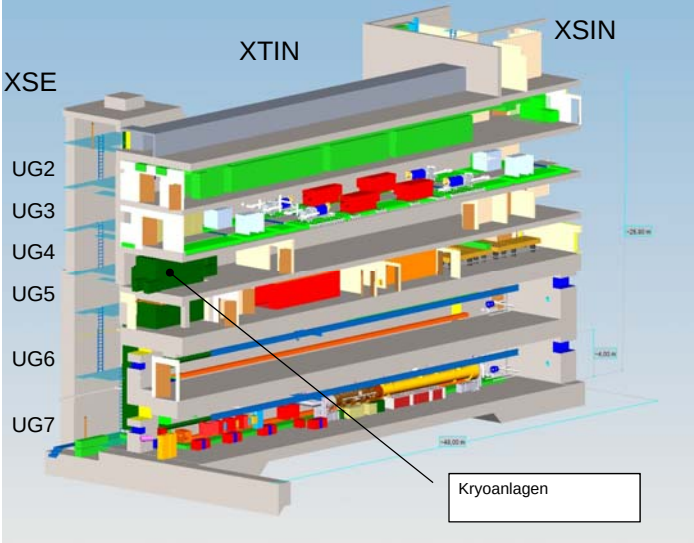
View into the hall XS1





Installation of cryo transfer line into XTIN media shaft last week


41



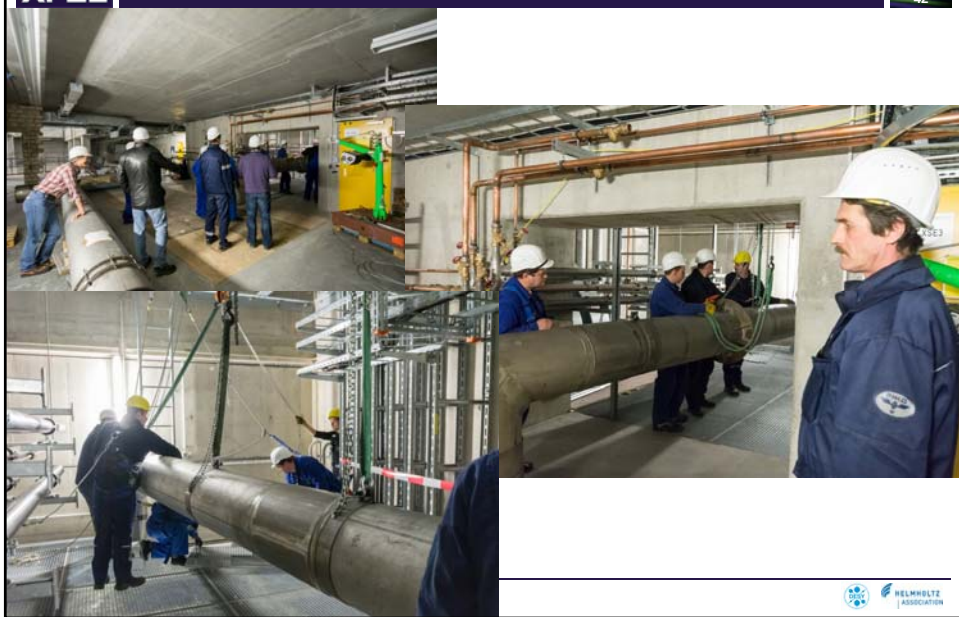
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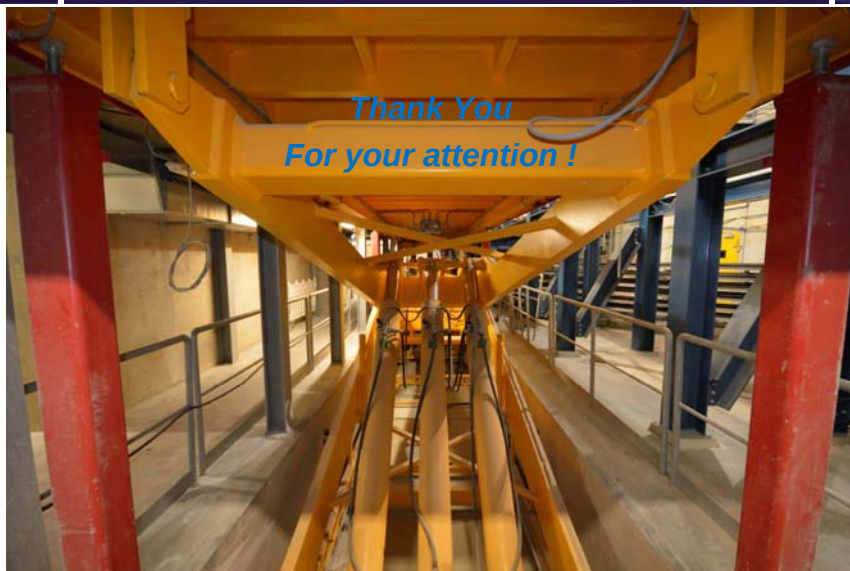



Installation of cryo transfer line into XTIN media shaft last week


42





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45

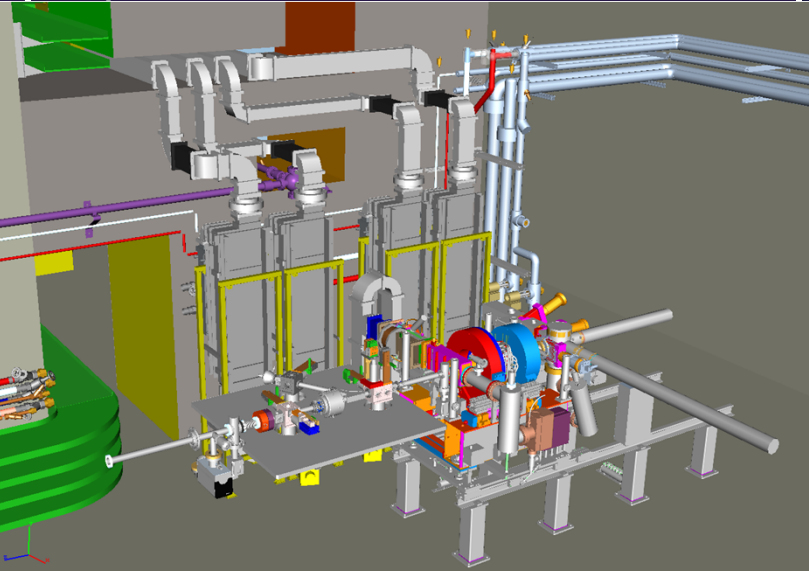
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The puzzle ...


46



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