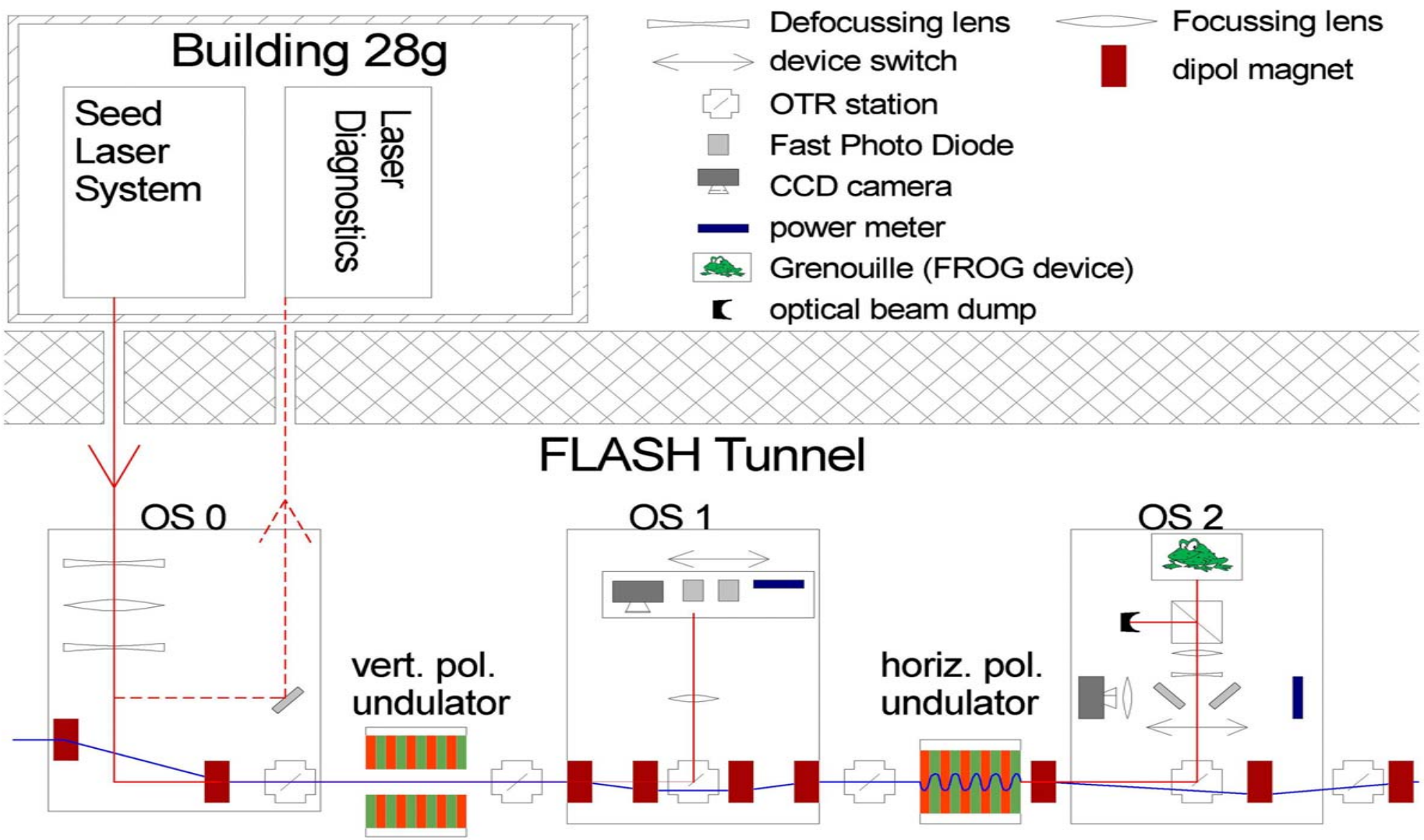
Installation of Optical Replica Synthesizer

G.Angelova

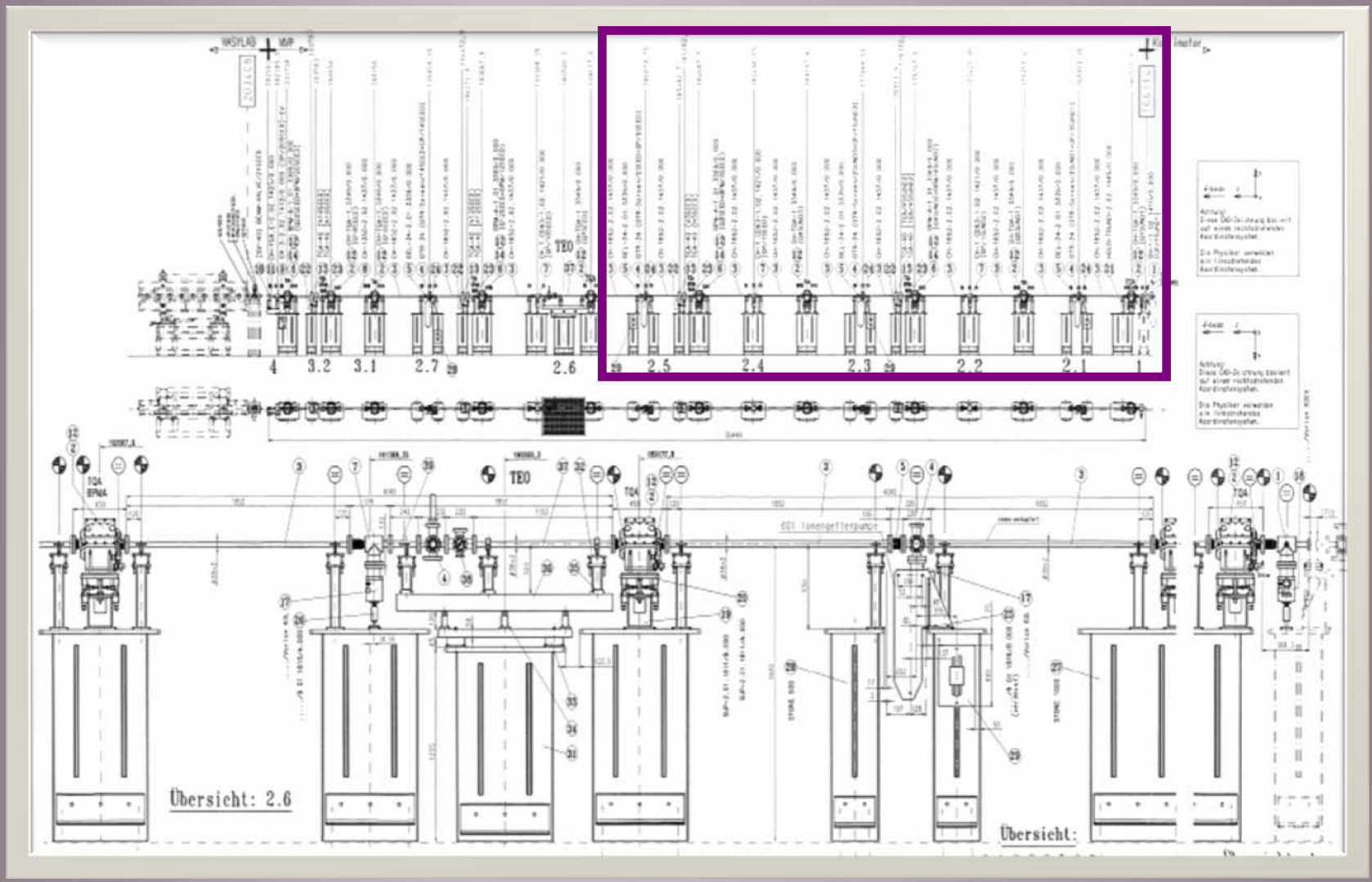
OUTLINE

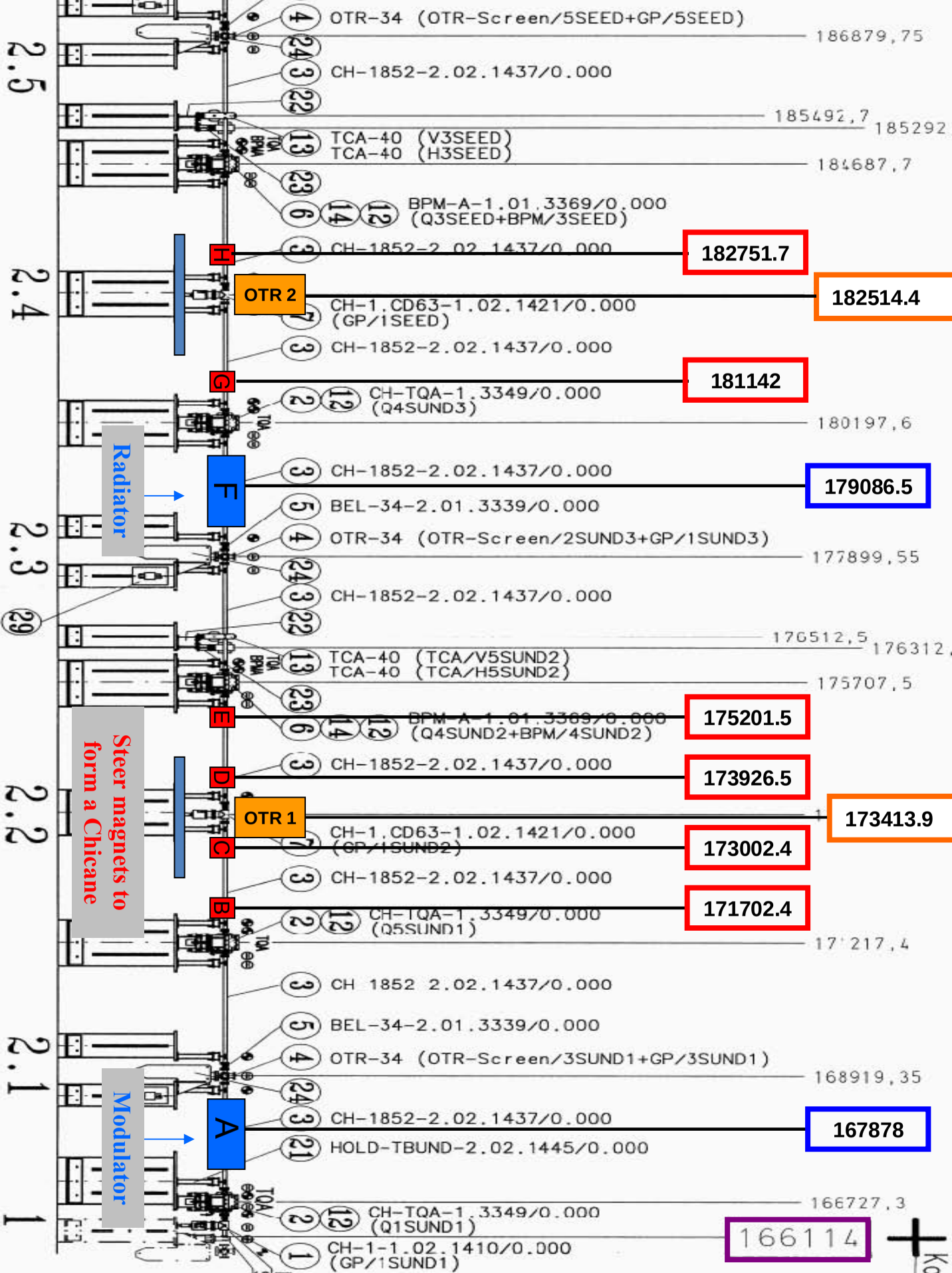
- How it works
- Where
- What
  - Undulators
  - Chicane
  - OTR
  - Optical Station I and II
  - Laser Transfer Line
  - Seed laser
- DOOCS control panels for ORS
- ORS logbook and website

HOW ORS works



WHERE in FLASH




OTR-34 (OTR-Screen/5SEED+GP/5SEED)
186879,75
CH-1852-2.02.1437/0.000
185492,7
185292
TCA-40 (V3SEED)
TCA-40 (H3SEED)
184687,7
BPM-A-1.01.3369/0.000
(Q3SEED+BPM/3SEED)
H
CH-1852-2.02.1437/0.000
182751.7
OTR 2
182514.4
CH-1.CD63-1.02.1421/0.000
(GP/1SEED)
CH-1852-2.02.1437/0.000
G
181142
CH-TQA-1.3349/0.000
(Q4SUND3)
180197,6
Radiator
F
CH-1852-2.02.1437/0.000
179086.5
BEL-34-2.01.3339/0.000
OTR-34 (OTR-Screen/2SUND3+GP/1SUND3)
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176312
TCA-40 (TCA/V5SUND2)
TCA-40 (TCA/H5SUND2)
175707,5
E
BPM-A-1.01.3369/0.000
(Q4SUND2+BPM/4SUND2)
175201.5
Steer magnets to form a Chicane
D
CH-1852-2.02.1437/0.000
173926.5
OTR 1
173413.9
CH-1.CD63-1.02.1421/0.000
(GP/1SUND2)
C
173002.4
CH-1852-2.02.1437/0.000
B
171702.4
CH-TQA-1.3349/0.000
(Q5SUND1)
17'217,4
CH 1852 2.02.1437/0.000
BEL-34-2.01.3339/0.000
OTR-34 (OTR-Screen/3SUND1+GP/3SUND1)
168919,35
Modulator
A
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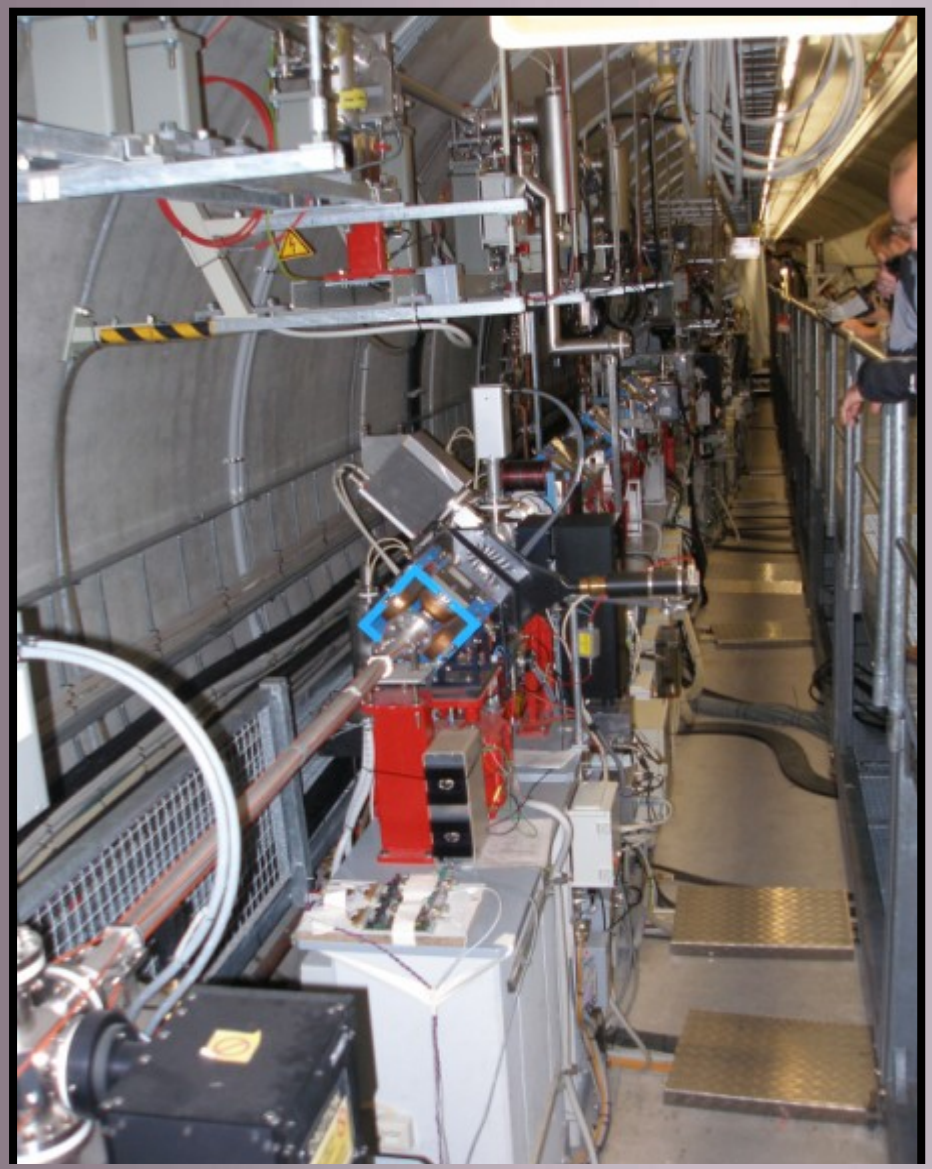
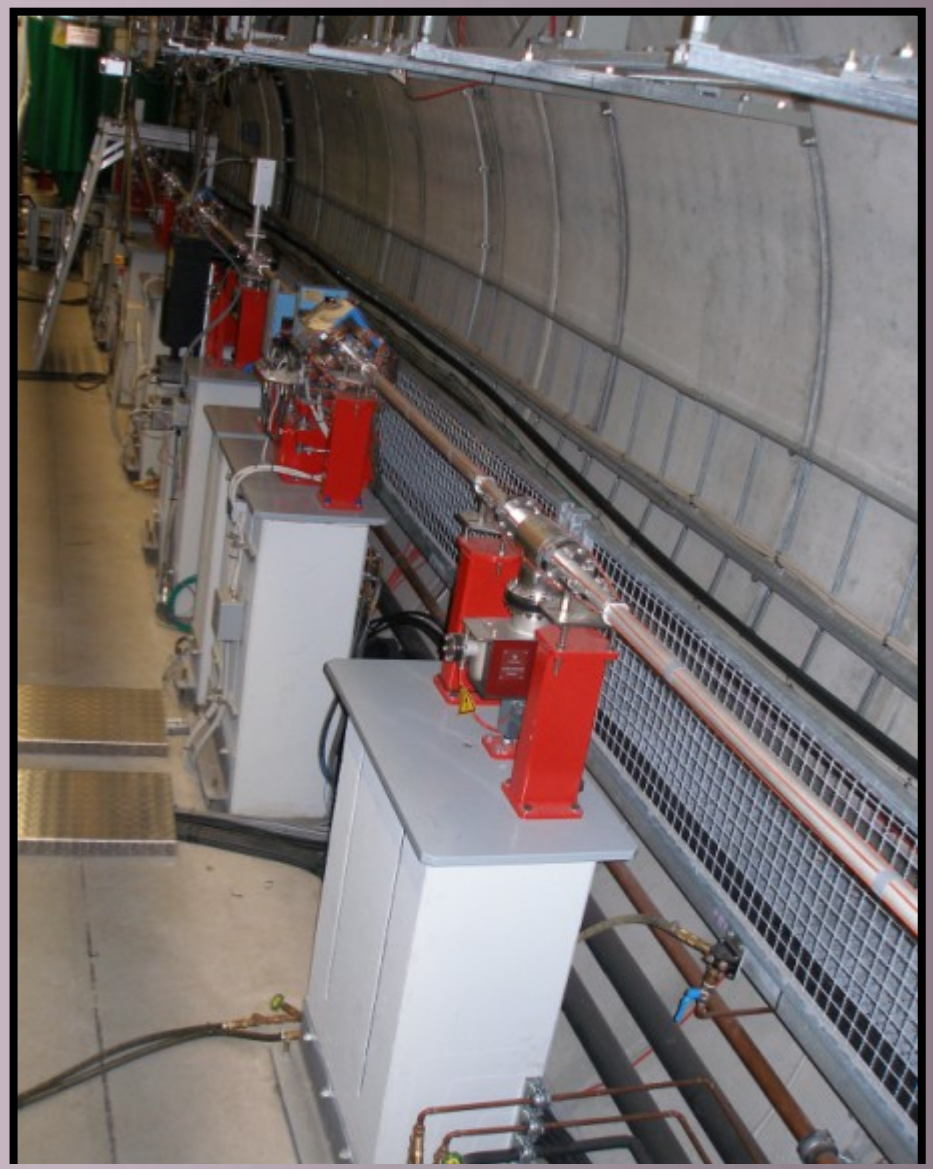
167878
HOLD-TBUND-2.02.1445/0.000
166727,3
CH-TQA-1.3349/0.000
(Q1SUND1)
166114
CH-1-1.02.1410/0.000
(GP/1SUND1)
2.5
2.4
2.3
2.2
2.1
1

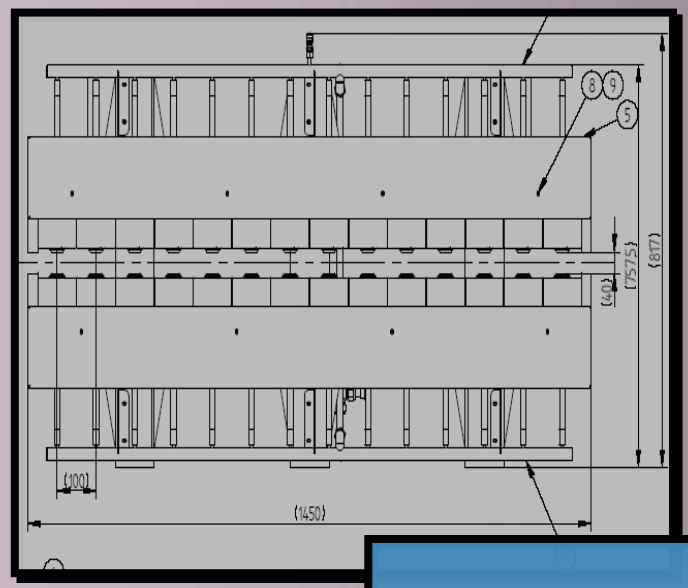
ORS sector before the installation

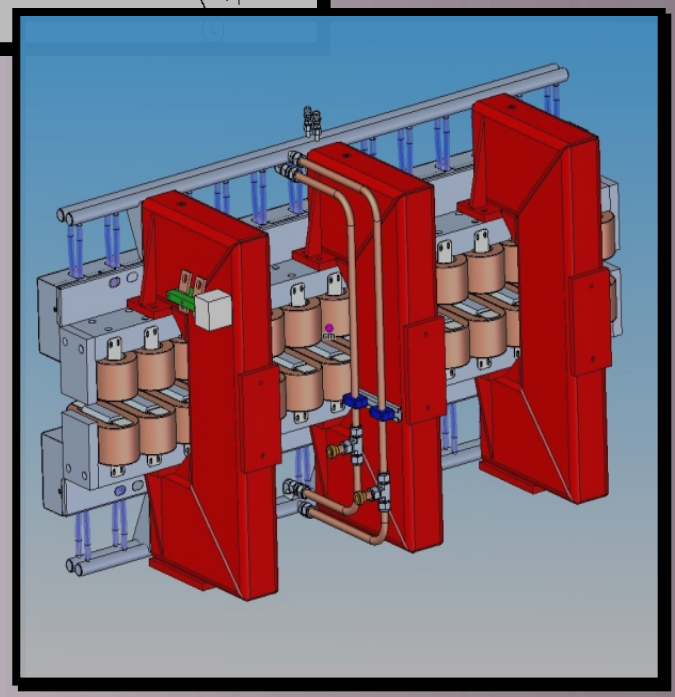




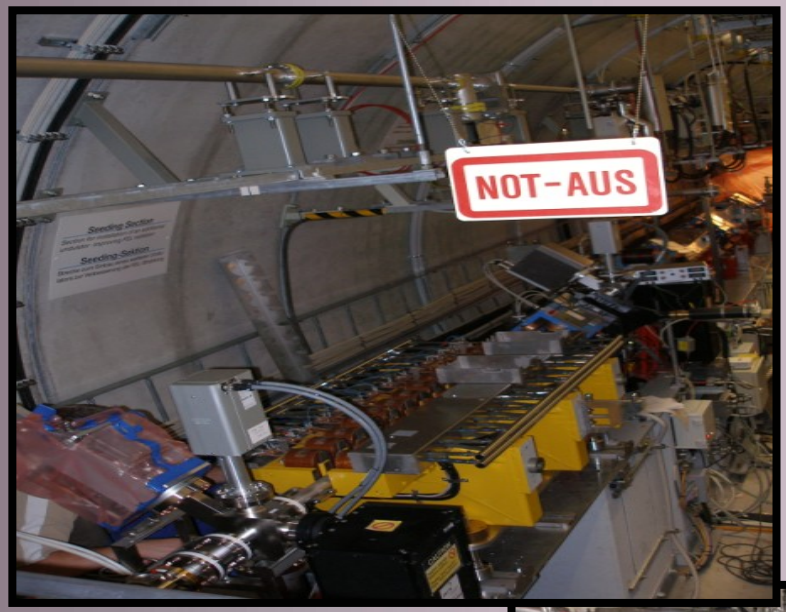
Undulators

Parameter	Value
Type	Electromagnetic
Number of undulator	1-2 (vert + horiz)
Gap	40 mm
Period length	200 mm
Pole length/width	50/100 mm
Number of full periods	5
Number of poles	14
Nominal field	0.31 T
Nominal K-Value	5.7
Maximal field	0.42 T
Maximum K-Value	7.7
Iron yoke length	1400 mm
Overall length incl. coils	< 1500 mm
Ampere-turns per coil	to be decided
Number of turns	to be decided
Maximal current	< 400 A, better < 100 A
Number of basic / end coils	10 main, 4 end coils
Vacuum chamber diameter	35 mm
First field integral	5×10^{-5} Tm
Second field integral	2×10^{-4} Tm^2



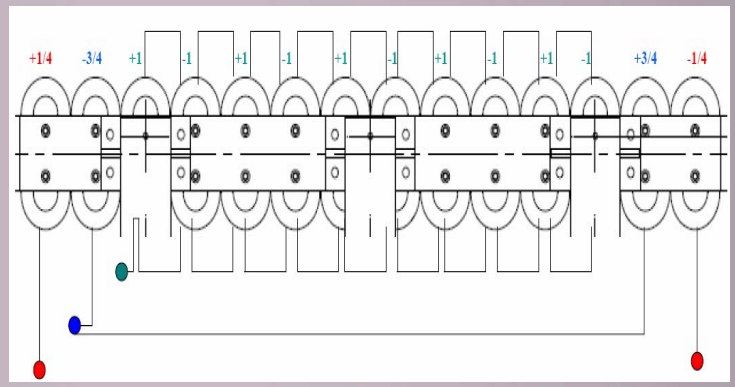


VERONICA and HILDA

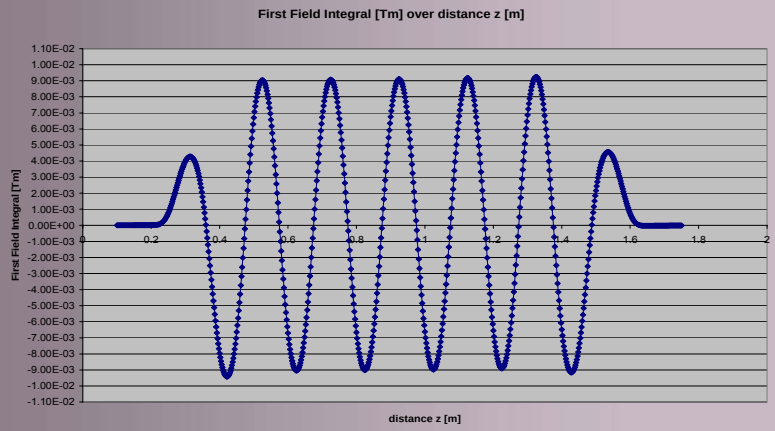


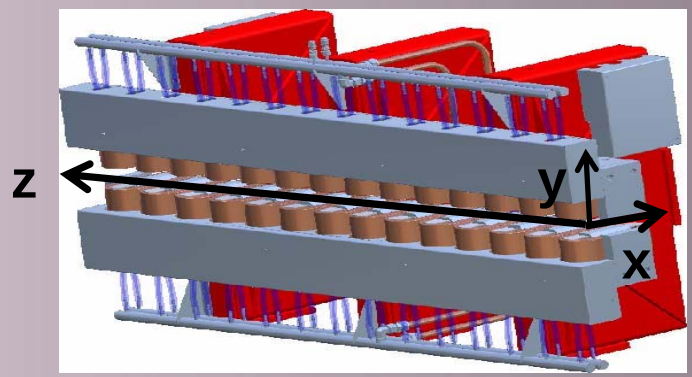
Field Measurments at DESY

- Let us name the peak field in the 10 equal poles B_0 The field in the outmost entrance pole B_1, second outmost pole B_2 and the field in the outmost exit pole B_3.From the start B_1 and B_3 should be tuned to ¼*B_0 and B_2 to ¾*B_0



- For each undulator the field measurements were performed along the beam centerline (z-direction) for five different levels of peak field strength: 0.1, 0.2, 0.3, 0.4, 0.48T. The measurements at 0.3T were performed also at x = ± 10mm and y = -4mm.





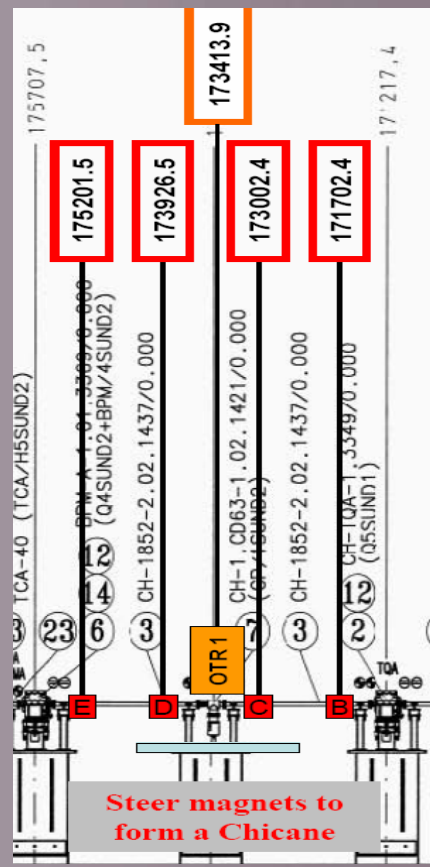
- At 0.3T of the radiator undulator which is be vertically placed gives values of -1.12 x 10^{-5} Tm for the first field integral (<5 x 10^{-5} Tm)

- Standardization cycle: 0 → 0.48 → 0 → set value

Chicane

Hardware:

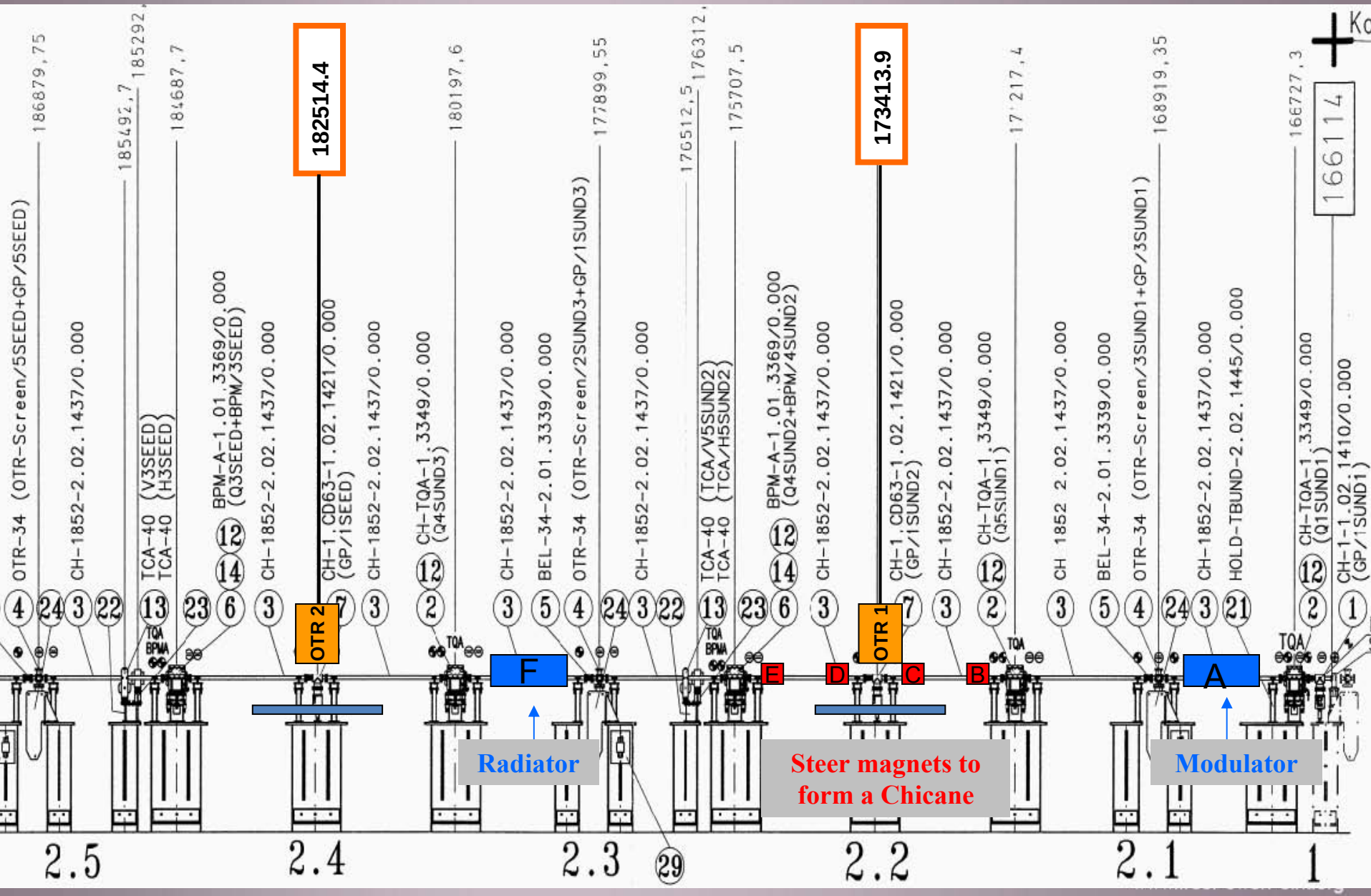
- Steerer magnets at 171.7, 173.0, 173.9, 175.2m
- Girders for 4 steerer (to form a chicane)
- 1.3 m between dipoles
- Power supplies till 3.5A



Theory

- Consists of four dipole magnets of equal field strength and magnetic length.
- Electrons just take a "detour" through the chicane while the beam direction at the exit remains unchanged. The amount of deflection can be adjusted by altering the field (the current) of the magnets.
- In such a chicane electrons with lower energy (with respect to the reference energy of the accelerated beam) take longer flight paths and are delayed in comparison to electrons with higher energy.

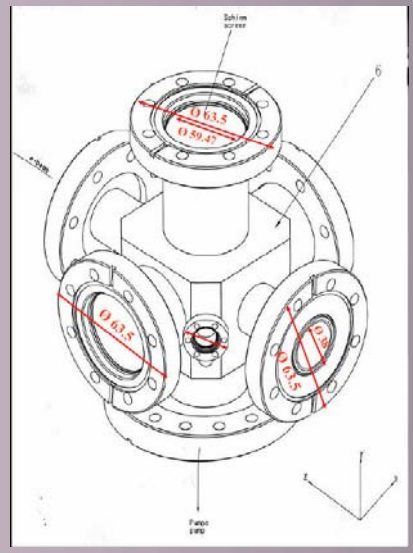
OTR stations

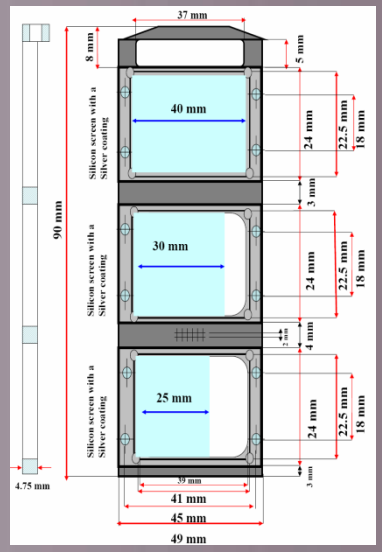


OTR chamber

Hardware

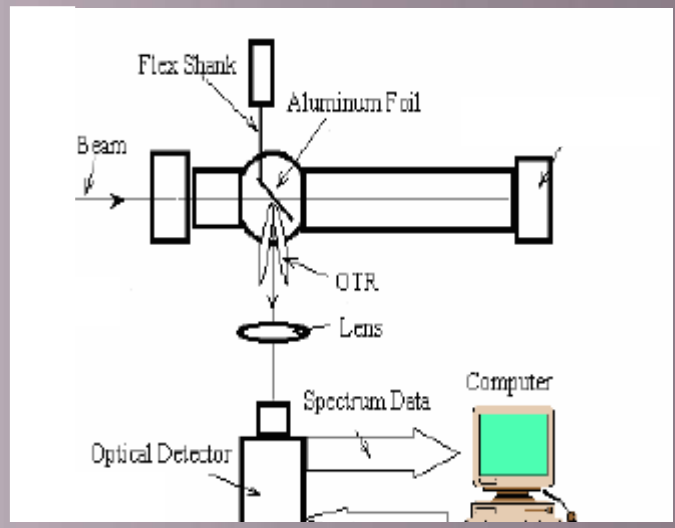
- OTR chambers + window: CF63, CF16
- OTR mover, cabling, interlock
- OTR frame
- Silicon wafers + Ag coating (extra pair with Al coating)



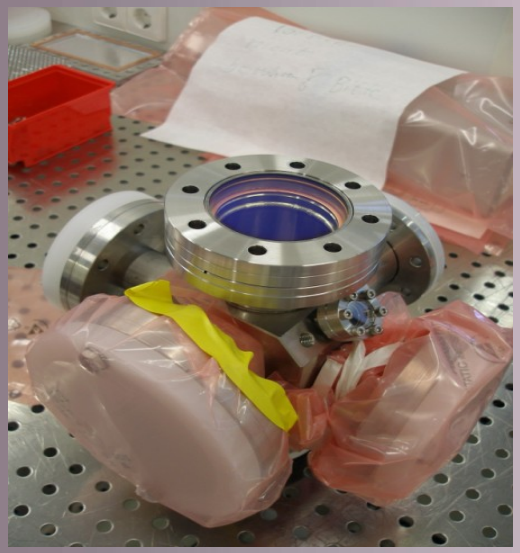


Theory

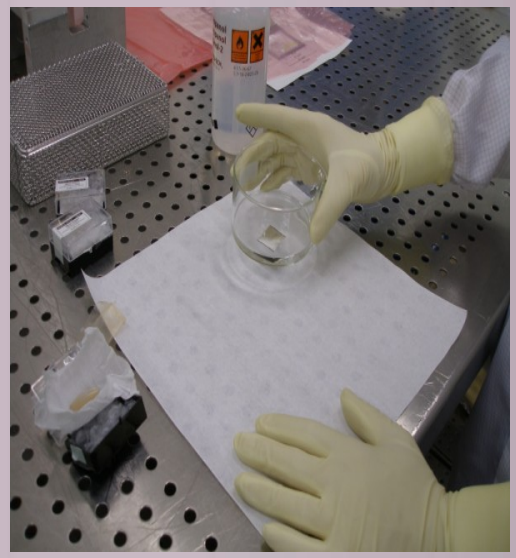
- occurs when a charged particle crosses the boundary between two media with different dielectric constants.
- if the electron beam incidence to the boundary at 45° the transition radiation appears at 90° to the electron beam direction.
- using the optical acceptance devices at the perpendicular direction to the beam, the transition radiation distribution will be analyzed.



OTR assembling



1



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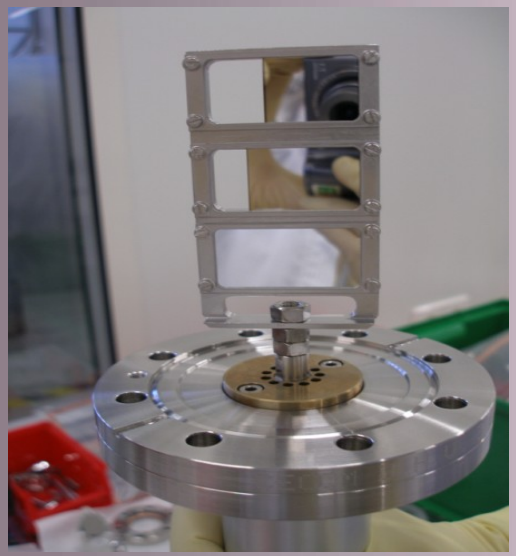

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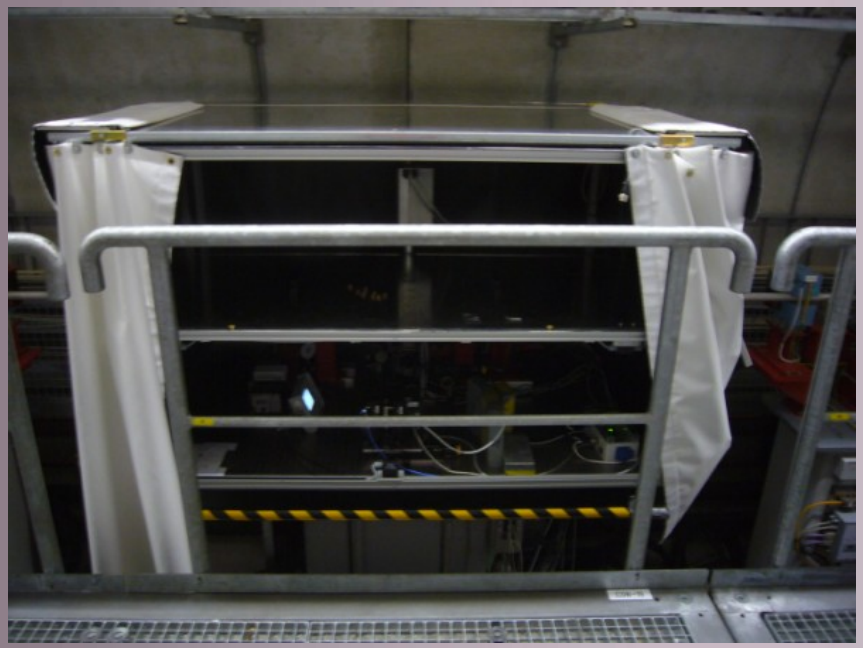
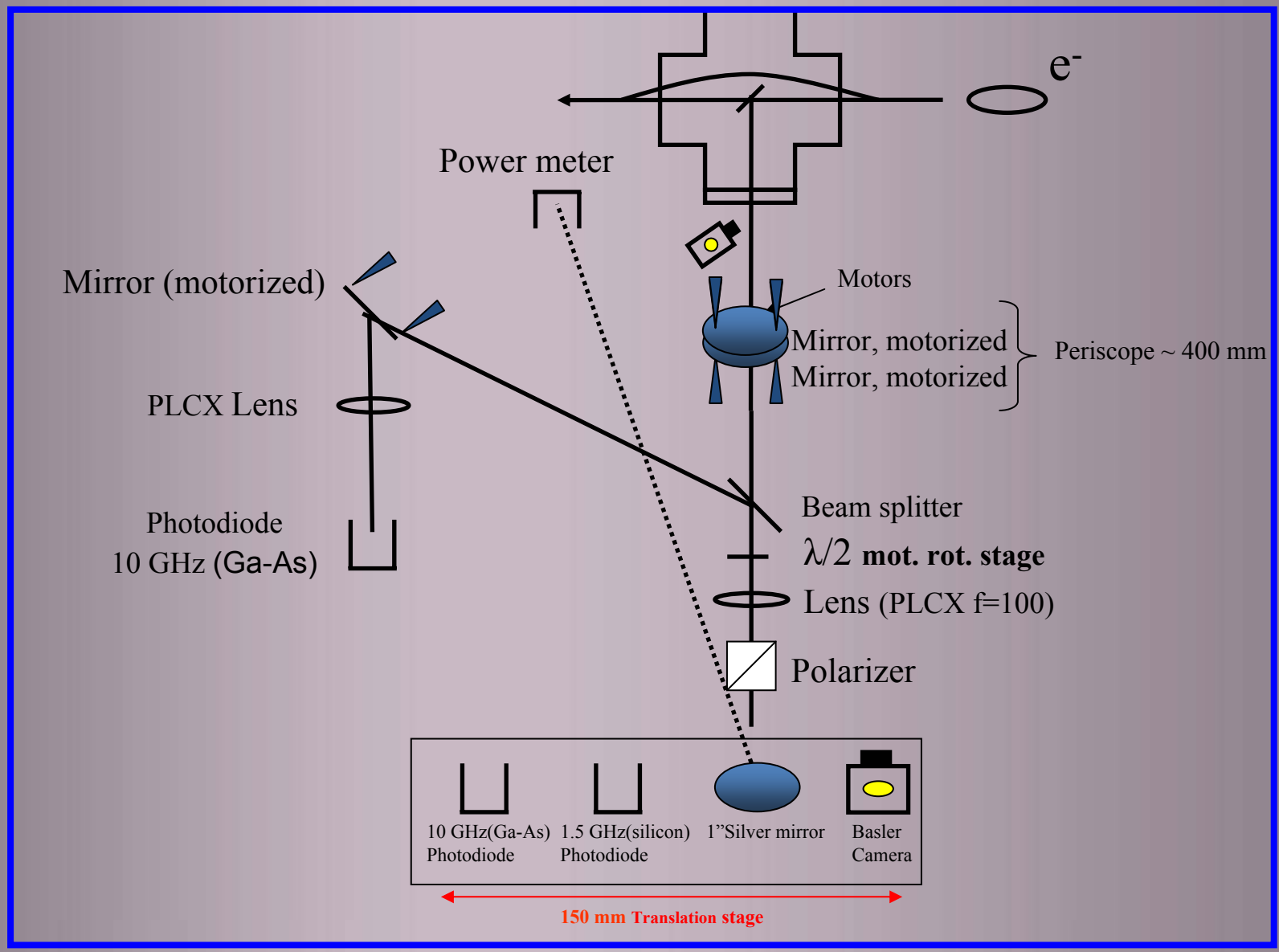
Optical Station I and II

Hardware:

- Optical table *(one per station)*
- Mechanical support for the optical table
- OTR chamber *(one per station):*window, frame, screens, interlock
- Laser shielding and interlock
- Optical components on the optical table



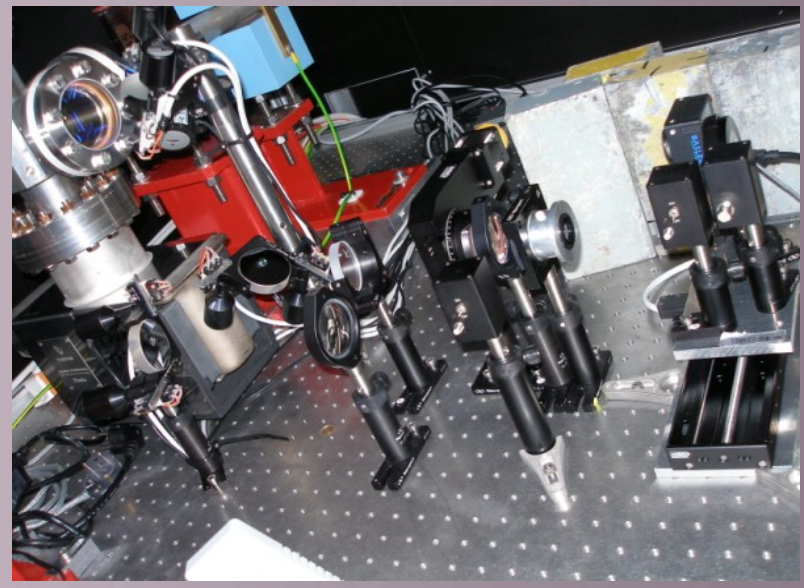
Optical Station I @ 173.43m



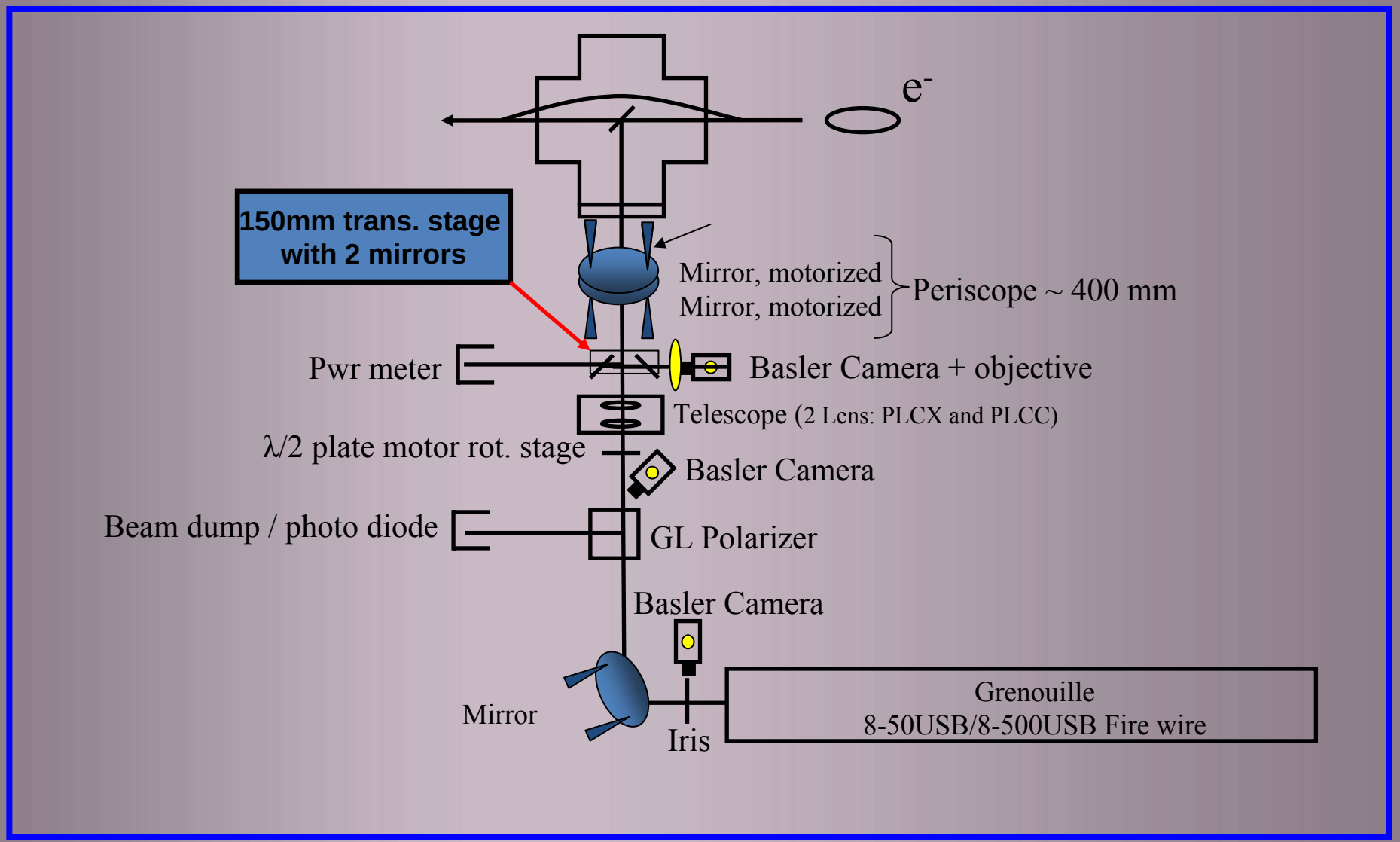
Optical Station I @ 173.43m

Purpose: To image

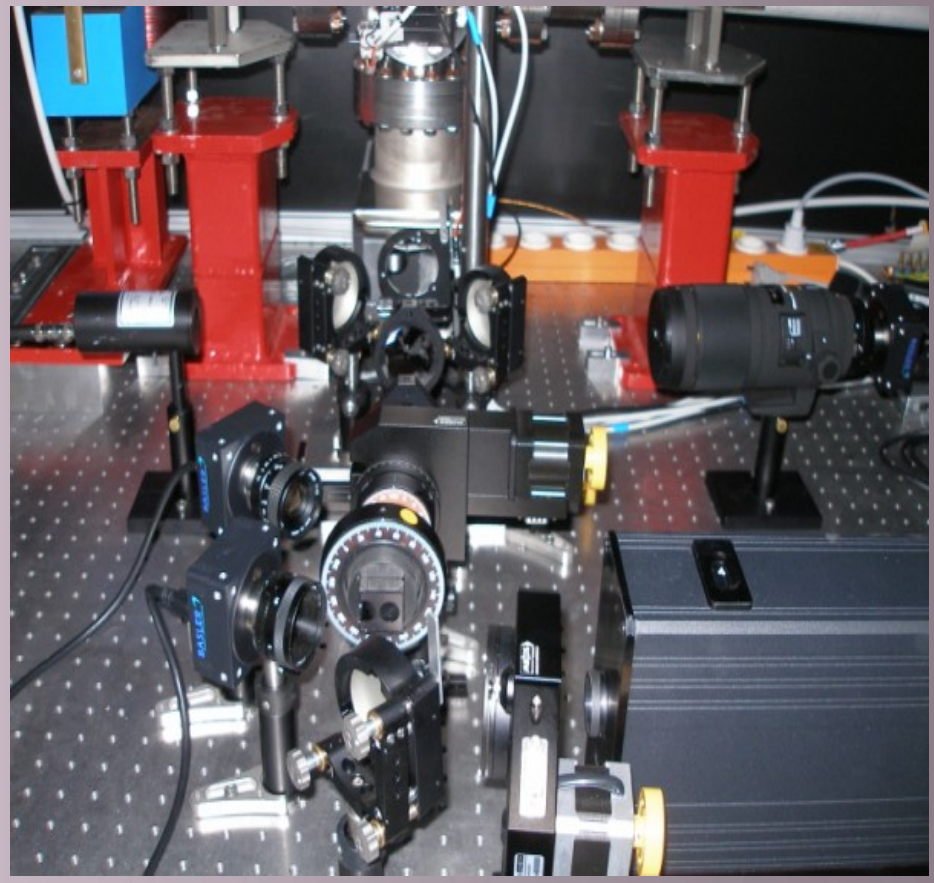
- the seed laser
- the radiation from the modulator
- the electron beam onto a CCD camera to optimize the spatial overlap of laser and electrons
- the electron beam onto a fast photo diodes to optimize the temporal overlap of laser and electrons.



Optical Station II @ 182.41m



Optical Station II @ 182.41m



Purpose: To analyze

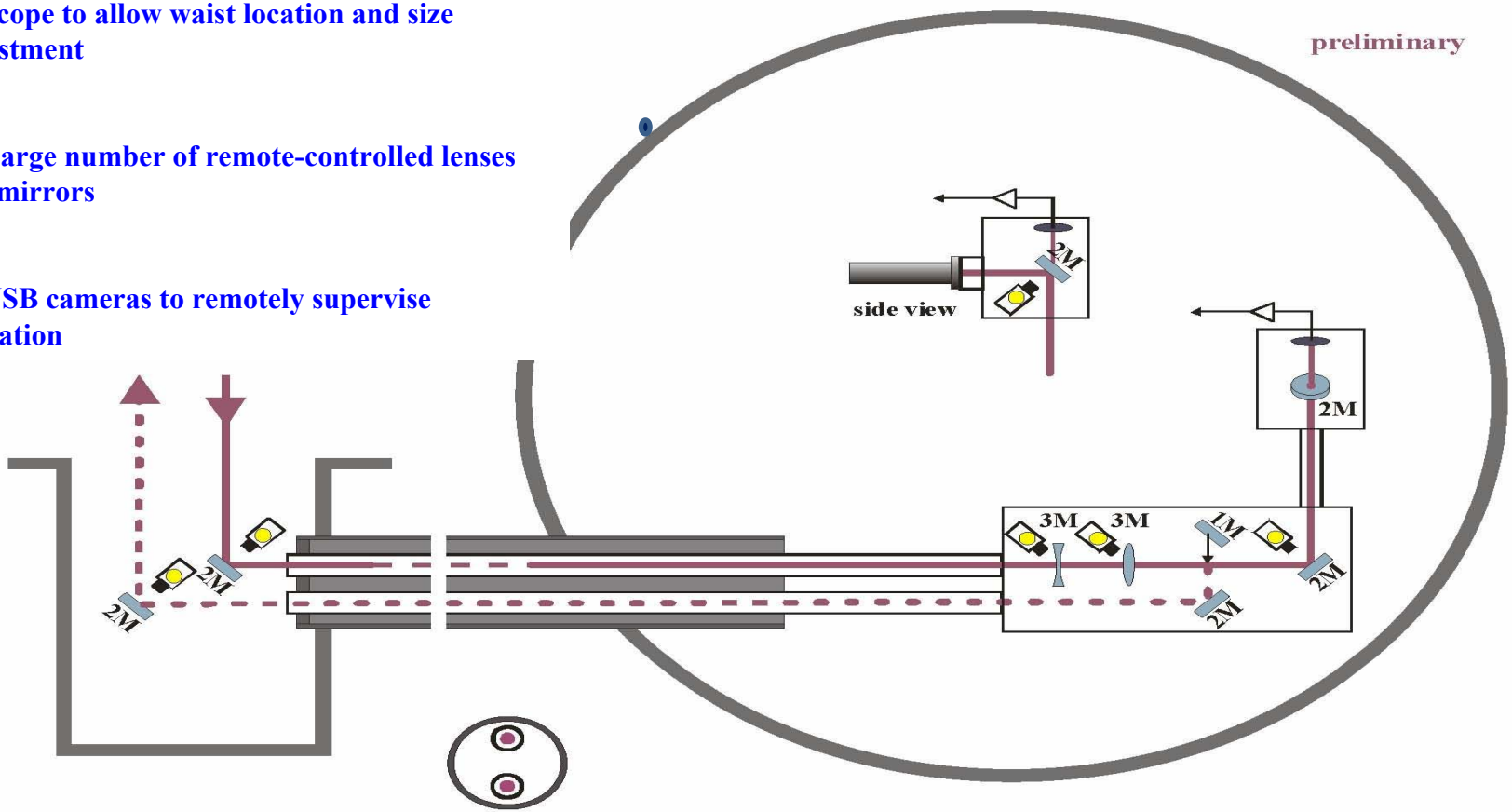
- the coherent pulse shape (Optical replica) using standard laser methods (FROG)
- the OTR radiaton after the modulator undulator

Laser Transfer Line

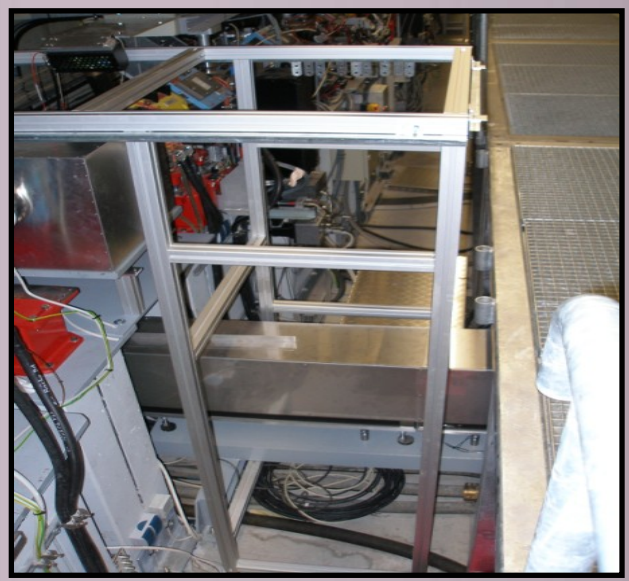
- **12 m long laser transport with 3 lens telescope to allow waist location and size adjustment**

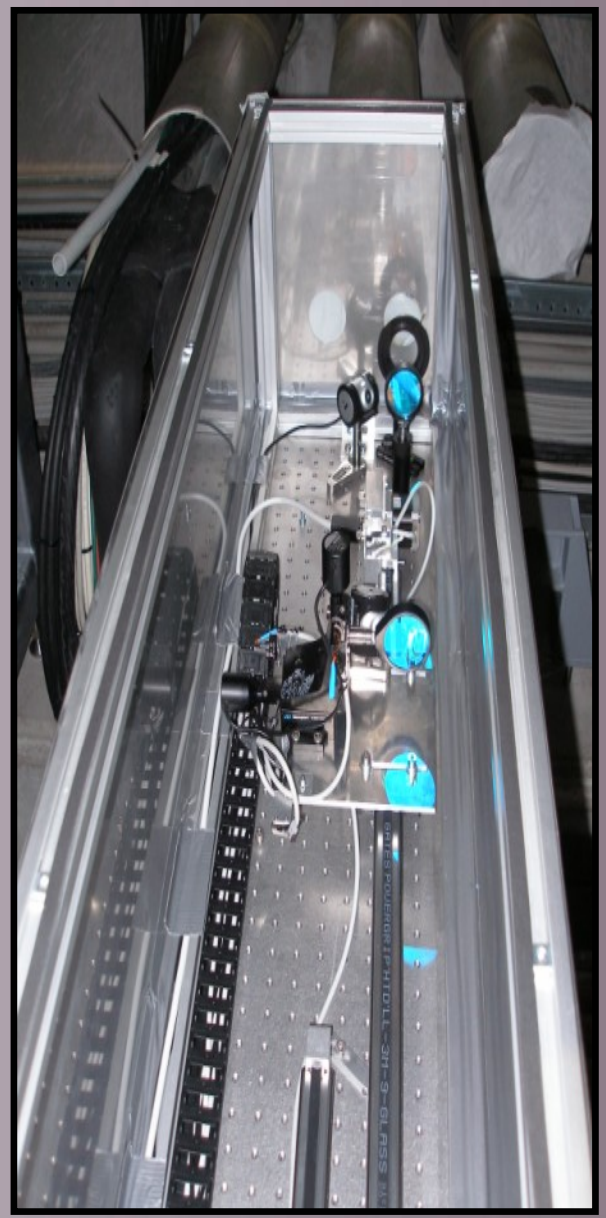
- **Large number of remote-controlled lenses and mirrors**

- **USB cameras to remotely supervise operation**



Laser Transfer Line





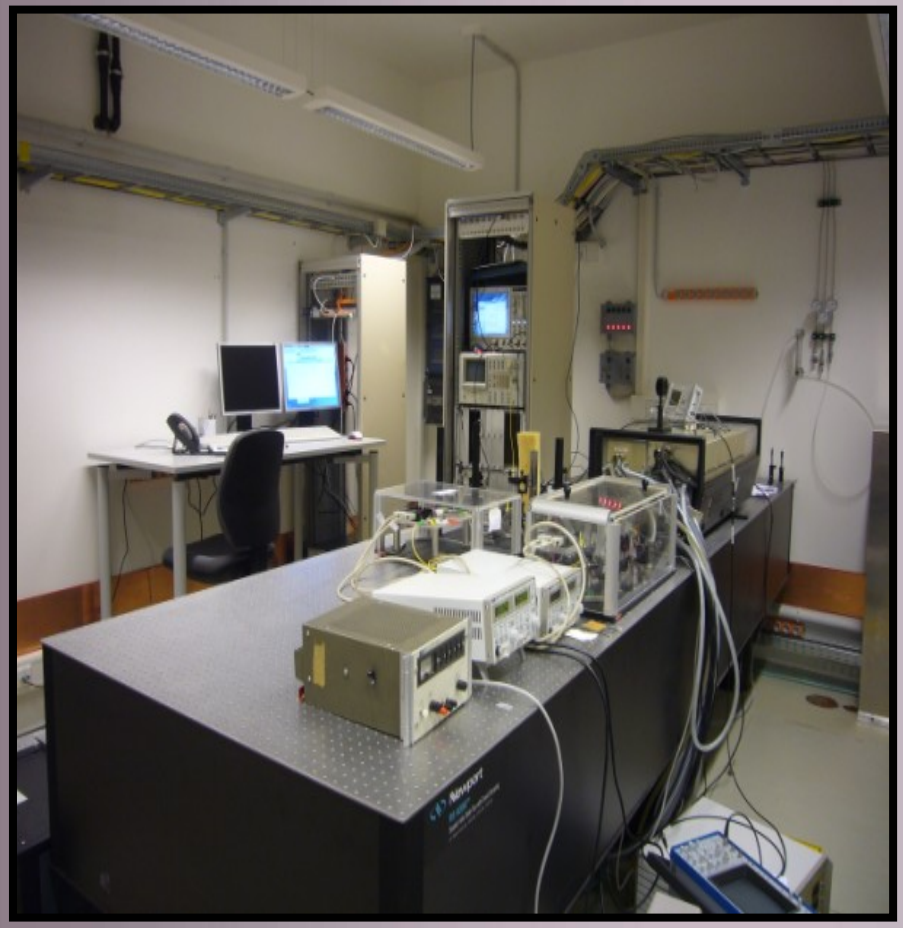
Laser Building outside

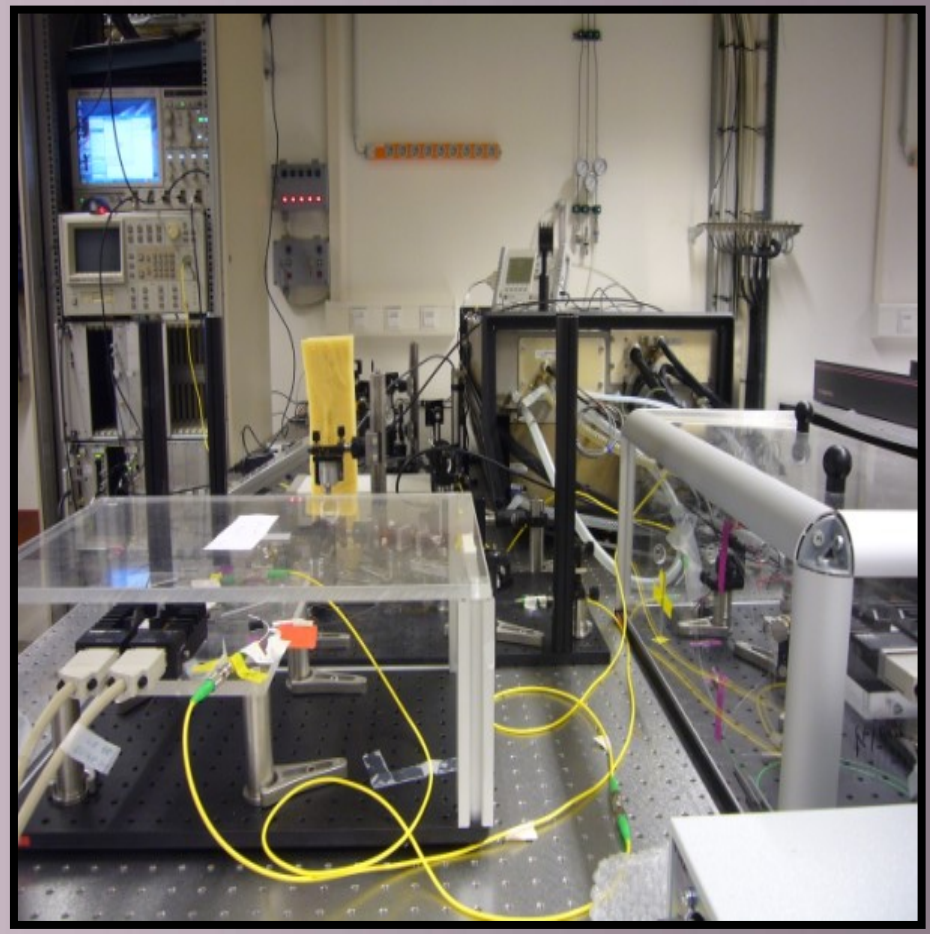
November 2006

February 2007

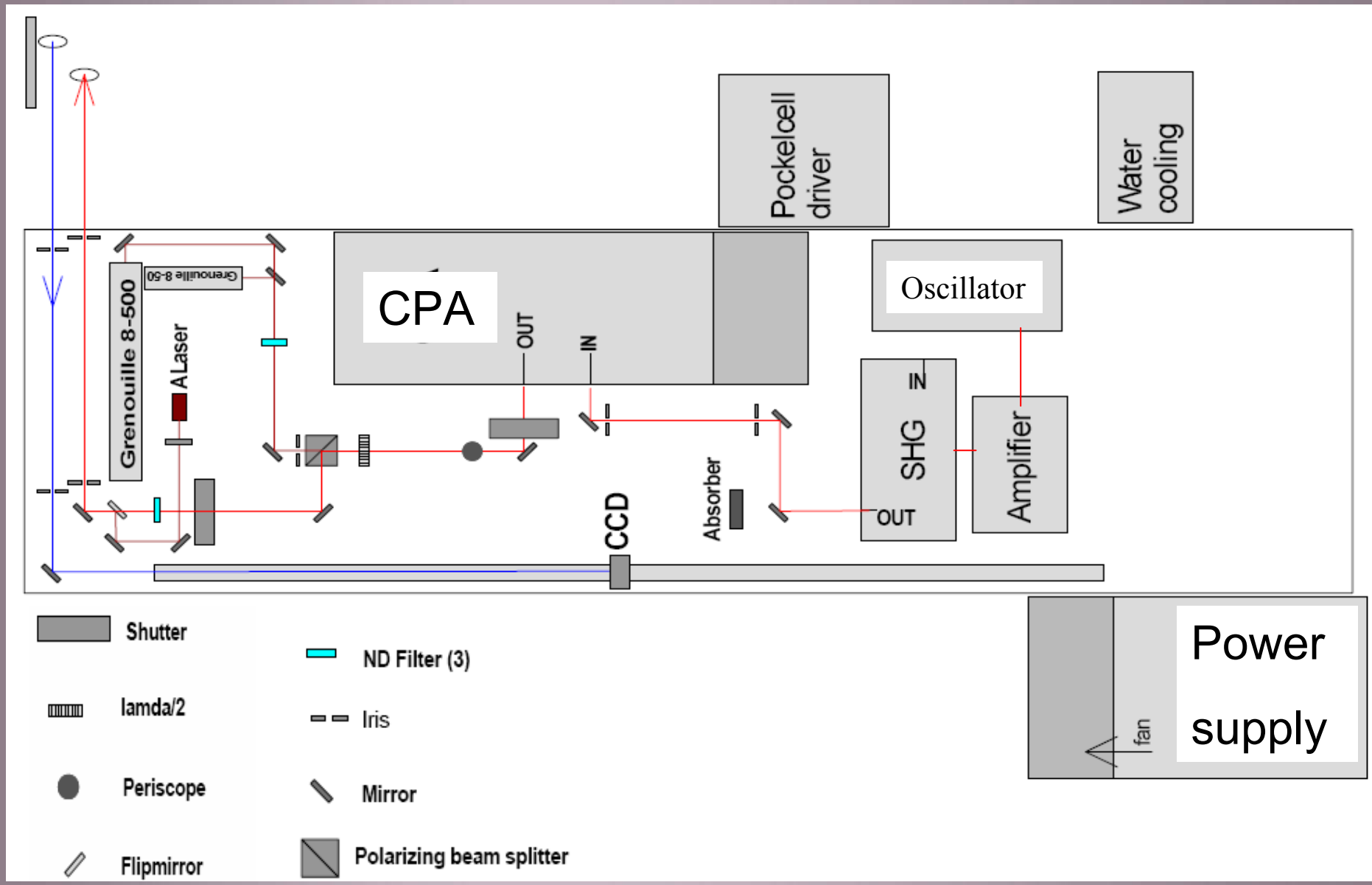
September 2007

Laser Building inside

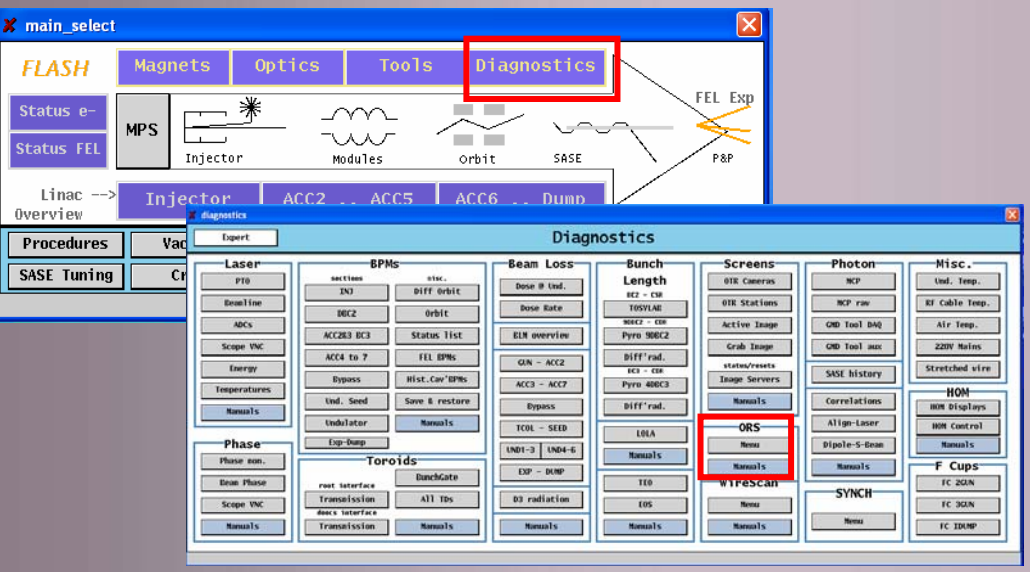


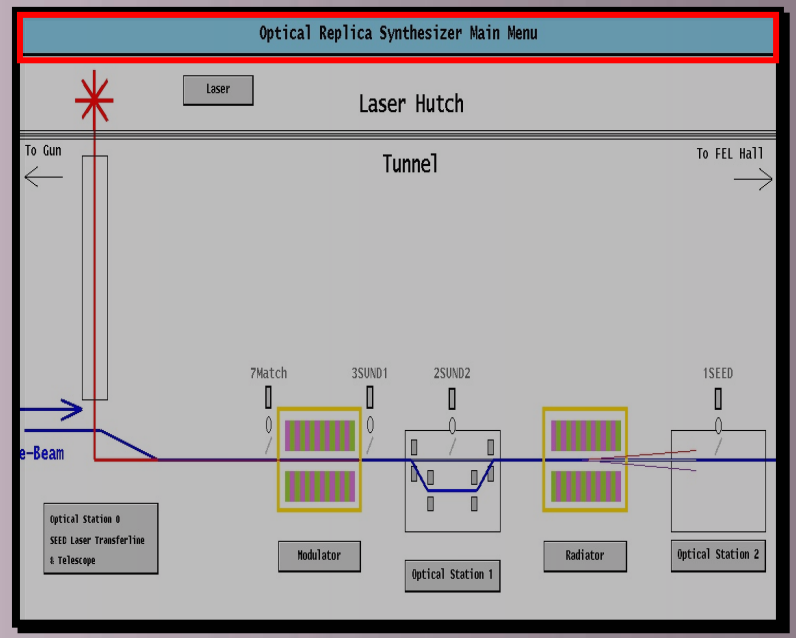


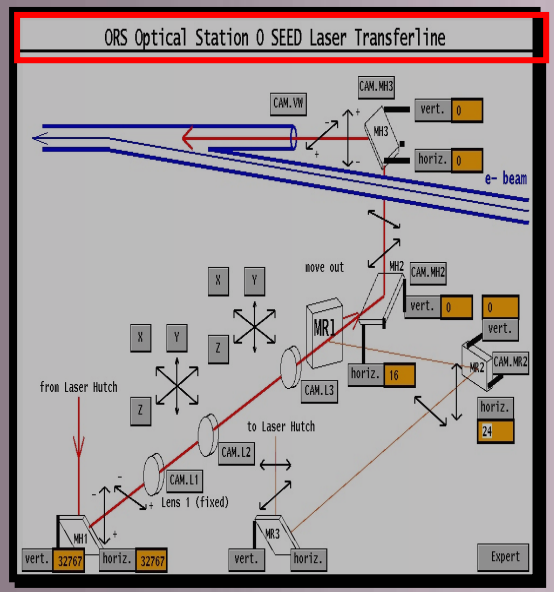
Seed Laser table LAYOUT

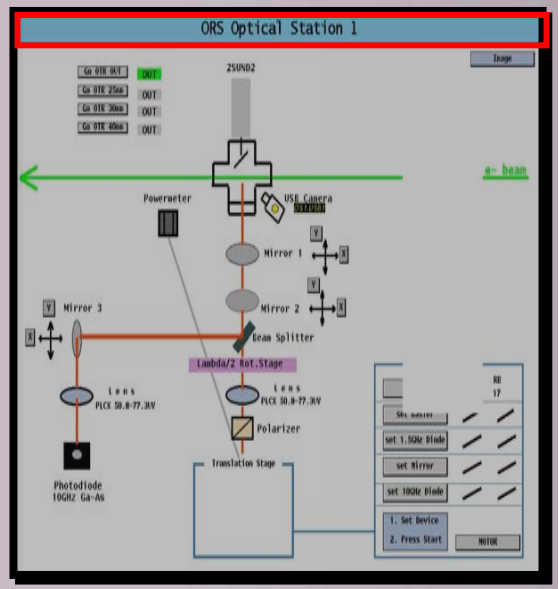


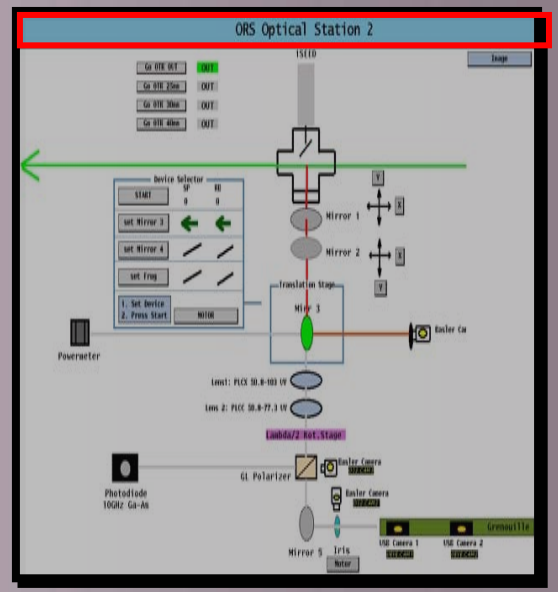
ORS Control System



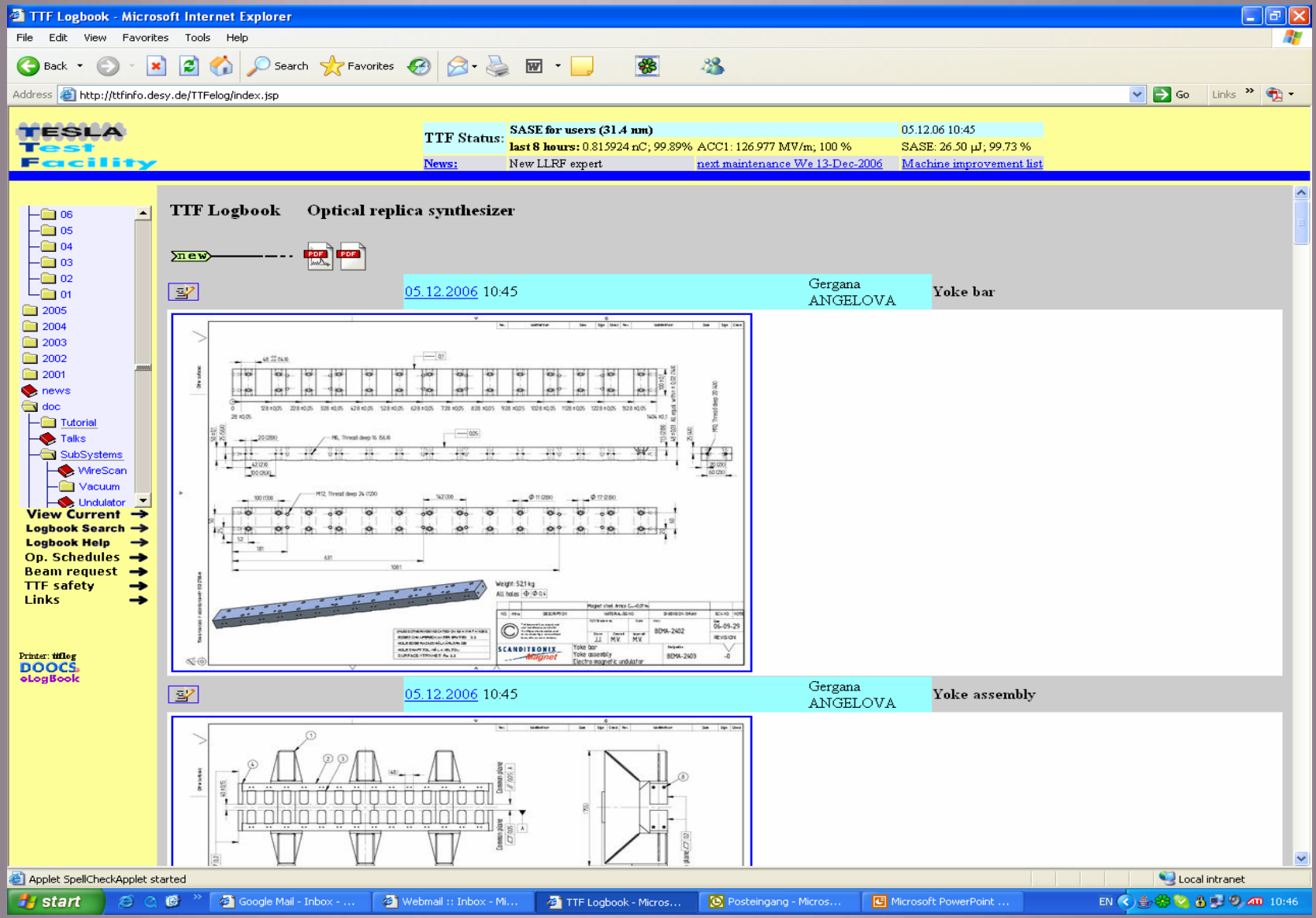








ORS Logbook



http://ttfinfo.desy.de/TTFelog/index.jsp

doc → SubSystems → ORS

Optical Replica Synthesizer - Windows Internet Explorer

http://www.tsl.uu.se/~gergana/

ORS website www.tsl.uu.se/~gergana

Optical | **Replica** | **Synthesizer**

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Efforts to build lasers in the x-ray region are now made in Europe, the US and Japan. In Europe, the XFEL project has started at DESY in Hamburg, and Sweden has decided to join this project.
Recognizing the international development of photon-based sciences, and identifying the potential for participating in this development for researchers in the Mälardalen region, the Royal Institute of Technology, Stockholm University, and Uppsala University has responded to the challenges by forming a Centre for Development and Research at Free Electron Laser Facilities.

Collaboration on Free Electron Laser Technology and research has been signed in December 2004 by

- Uppsala University, Sweden
- Stockholm University, Sweden
- Royal University of Technology KTH, Sweden
- DESY, Hamburg , Germany
- University of Hamburg, Germany

The purpose of this collaboration is to design, construct, implement and test the Optical Replica Synthesizer for the FLASH FEL facility.

The ORS is a new and experimentally unproven approach towards bunch characterizations at FEL facilities and the project is initially directed towards obtaining a 'proof of principle' of the technique.

According to the time schedule the ORS was installed between April 2007 and June 2007 (when the FLASH facility is temporarily shut down), and started to operate between June 2007 and the summer of 2008.

For more information please check **FLASH TTF Logbook**

Internet | Skyddat läge: På 100 %

Optical Replica Synt... | Microsoft PowerPoi... | Dokument - WordPad | SV 16:53

Conclusions

Installation of ORS Elements 

Installation of the seed laser 

Installation and Alignment of OS I and II 

Motorizing some opt. elements in Laser Hutch in progress 

It is not over yet …

What happened during our shifts in the following talk

Thank you for the attention!!!