Status Report on the Alignment Efforts @ DESY

Wolf Benecke, Martin Noak, Johannes Prenting
(DESY, Hamburg, Germany)

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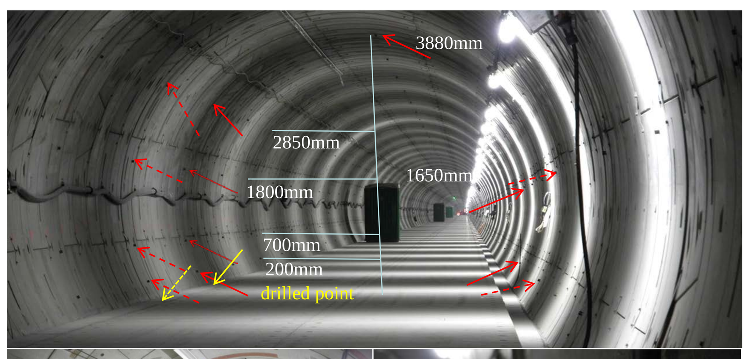
European XFEL

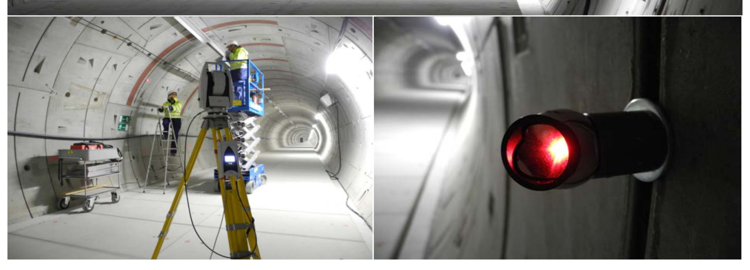
Reference Grid

First access to some of the XFEL tunnels was granted in January 2012. We started our measurements in the XTD1, two months later the accelerator tunnel section, XTL was accessible. Currently there is no access to the other sections. After the fiducial marks have been installed, the first survey run was started. For this network survey a Leica tracker AT401 on a wooden tripod has been used. The fiducial marks have been attached to the tubbings segments in c-shaped rails every 9m. Each ring consists of eight points (one being located at the concrete floorborder).

Measured section length:

XTD1	500m	number of rings: 48	diameter: 5,30m
XTL	2000m	222	5,30m





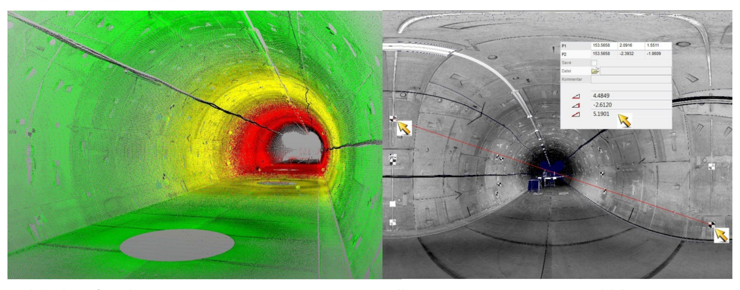
For a statistically good determination of the network geometry there have been observed four rings forward and backward from one survey station in two-face-measurement. The laser tracker has been placed in between two rings. After finishing the measurement on this instrument stand the tracker is moved only in between the next two rings. In addition, levelling points have been observed alternating from right to left side with a point distance of 27m. Network adjustment of laser tracker and leveling data has been carried out with PANDA as a free network.

number of observations:	37426
number of net points:	1783
number of datum deficiencies:	4
CPU time (full cov.-matrix):	~16min

The max. semi-axis of the error ellipses for the 2km network is ~3.0mm lateral and ~0.7mm vertical with error probability of 5%. The coordinates are being used for stake out only.
For the machine alignment there will be more survey runs in future. To enhance the precision, the laser tracker will be fixed to the wallmounted survey rails. Additionally the tunnel reference grid will be enhanced by the Straight Line Reference System (SLRS) in specific sections for an alignment accuracy of 0.5mm/1000m.

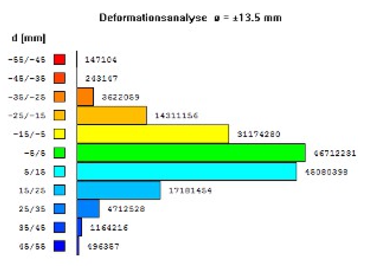
3D Laser Scan

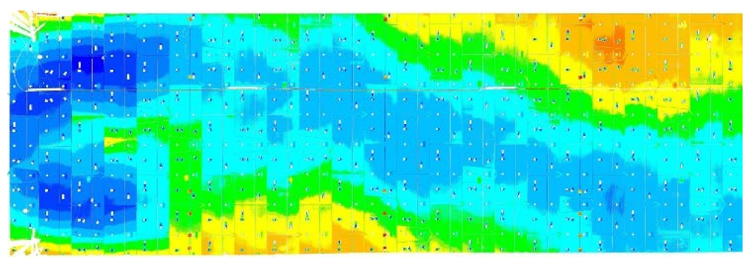
Machine documentation is expanded in the future to laser scanner data. By using laser scanner it will be possible to quickly produce 3D documentations of interiors and technical installations. For this documentary the laser scanner FARO Focus 3D is used. The XFEL tunnel geometry will be determined in two ways. Firstly through the net points and secondly through the laminar point detection by the scanner. The parameters were chosen that the scanner produces 3D point clouds with a dot pitch of 6mm to the distance of 10m. The scan stationary was placed between two reference point rings. Every scan has been transformed to the XFEL tunnel reference grid, which is relating to the machine axis. Thus it is possible to directly measure coordinates within the spatial scans. This possibility is currently being used in particular by the designers and planners of the machine installation process to easily identify certain dimensions even without having to go into the tunnel.



3d Point cloud — distance measurement within scan

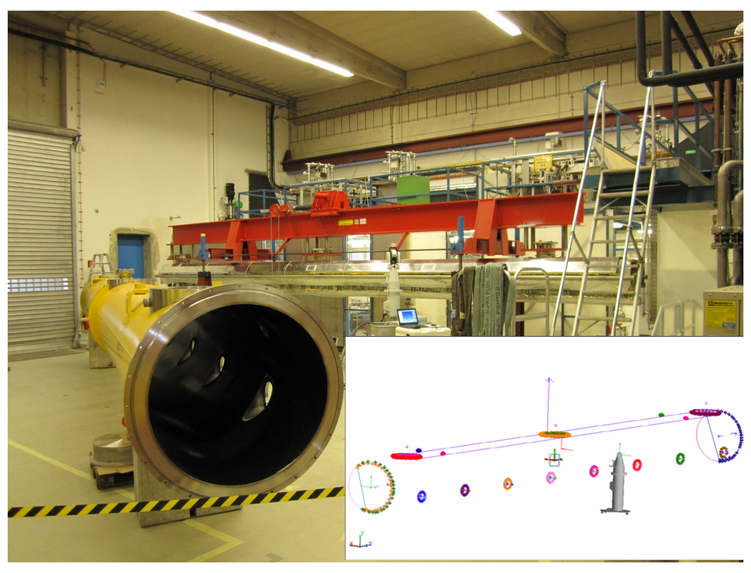
The laminar point detection by the laser scanner can be used for a deformation analyses. Deformations can sometimes be recognized with the naked eye. However, it is not possible to determine where the greatest discrepancy is located without a great deal of work. Due to the high density of measurement points recorded during a laser scan it is possible to determine the quality of deformations in a short time. In our case a norm cylinder of the tunnel was compared with the measured tunnel geometry and projected into a plane.





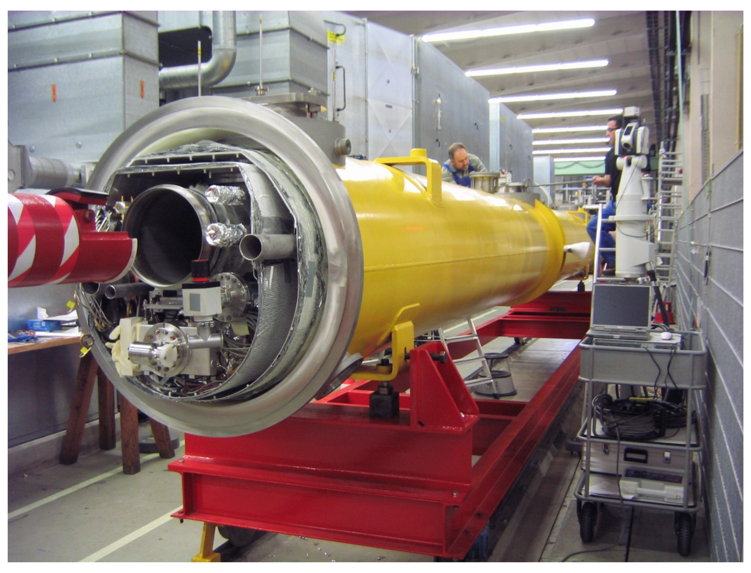
Flat projection of deformation analysis

Modules



Cold mass and vessel

The European XFEL is being realized as a joint effort of many partners. Thus, inter alia, the vessels and cold masses of the accelerator kryo modules for the XFEL will be produced by ZANON (Italy) and IHEP (China). In a next step the modules will be assembled at CEA (France) and shipped to DESY. Later we will align this modules in the tunnel only. During the prototype development of XFEL – modules we have designed the survey procedures for an intake control of the vessel and the cold mass, the alignment procedure of the cavity string and the alignment of the cold mass in the vessel. At the end all procedures will guarantee an assembling accuracy of better than 0.2mm. With a transfer of knowledge we supported our colleagues in China, Italy and France to do their work well.



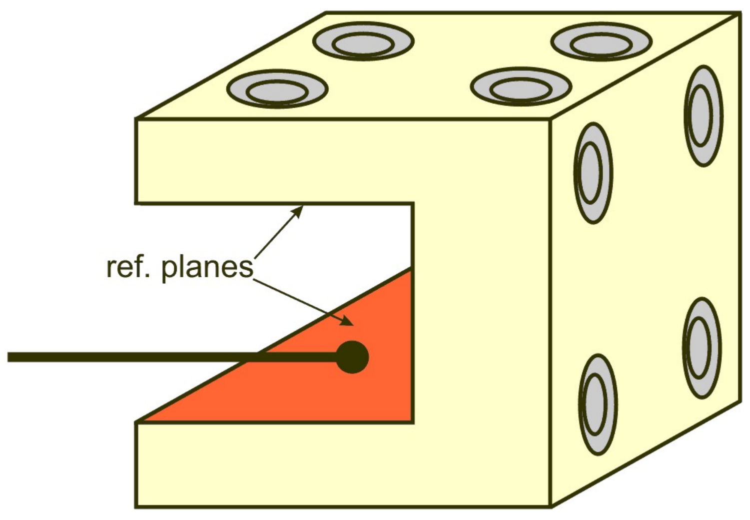
Aligning the cold mass into the vessel

Undulators

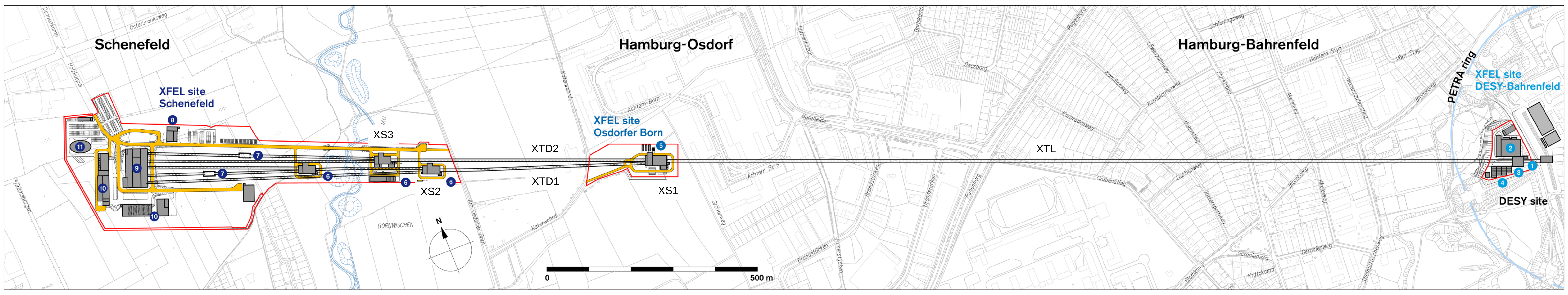
New type of undulators

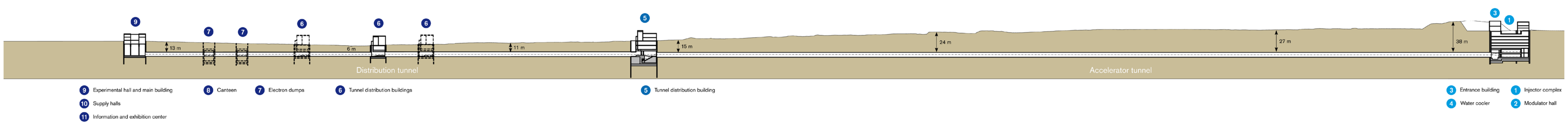
New Procedure for the Fiducialization Measurement

More than hundred undulators will be installed into the XFEL. To simplify the process of the fiducialization measurements, we will use the mechanical measurement of the gap, which is done by a measuring machine of the undulator group (FS-US), directly to define the beam axis. Reference planes on each end of the undulator enable the transfer from this mechanical to the geodetic reference system.
A successful operation would reduce the required work down to 50 percent.



Draft of one of the reference planes with a scanner





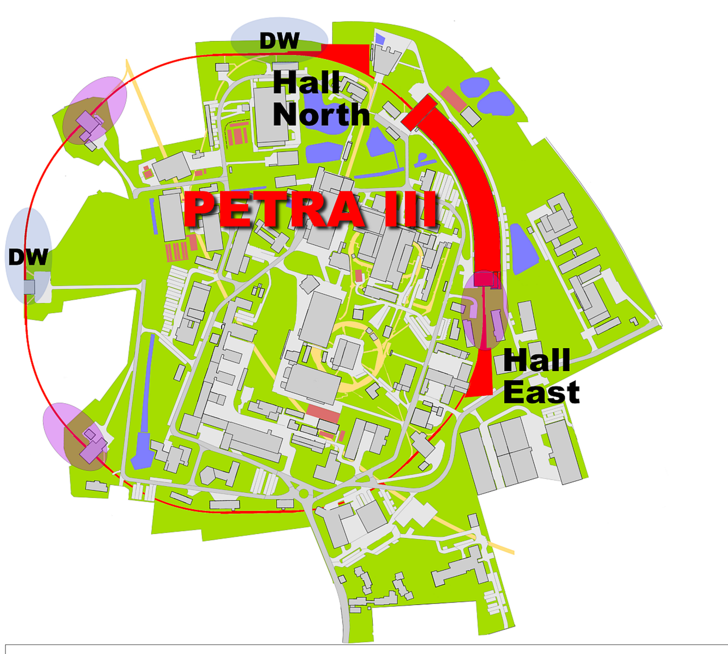
PETRA III EXTENSION

Overview

The focus of PETRA III is on applications making optimum use of the high beam brilliance, i.e., experiments aiming at nano focusing, ultra-high resolution studies, coherence applications etc.. Other techniques which require photon flux but not necessarily brilliance are being continued very successfully at DORIS III which is operated in parallel to PETRA III sharing its chain of pre-accelerators.

It has been decided to end the SR operation at DORIS III on Oct. 22, 2012. Some very productive beamlines and instruments serve techniques which are not currently implemented at PETRA III. In order to carry on these activities and to provide competitive beamlines and instrumentation for these applications, the experimental facilities at PETRA III will be extended to provide additional beamlines. Overall, there are several options for extension buildings along the circumference of the storage ring, specifically at the long straight sections which are well-suited for insertion devices.

This current extension project comprises two new experimental halls on either side of the large new PETRA III hall (North and East) making use of the long straight sections and the adjacent arcs. The northern straight section already accommodates one of the 40 m long damping wiggler arrays producing an extremely hard and powerful X-ray beam which can also be utilized for experiments. The long straight in the east is available for additional insertion devices.



View of the PETRA III storage ring (red line) showing the present experimental hall together with the planned additional experimental halls in the North and East. Overall options for additional extensions at the long straight sections of this ring are marked with shaded ovals. Two of these are accommodating the damping wiggler (DW) arrays.

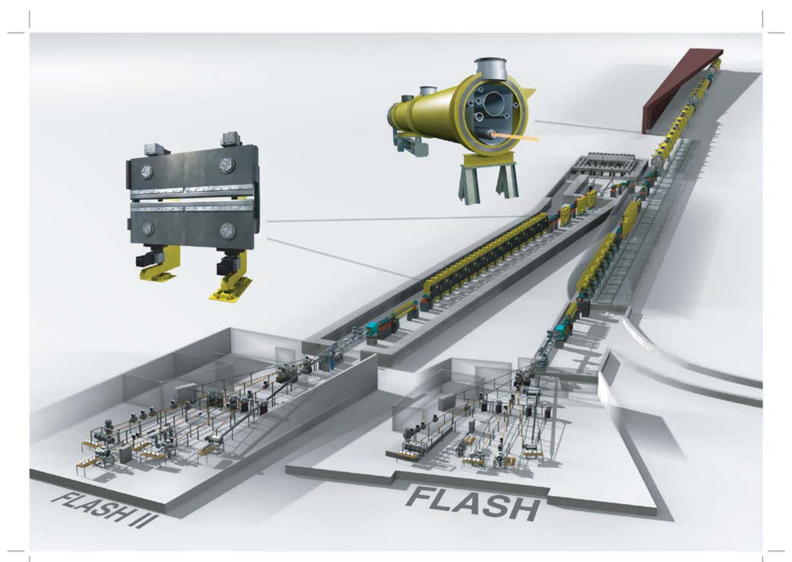
FLASH II

Extension of the FLASH Facility with FLASH II

A major extension of the FLASH facility is FLASH II which was a combined proposal by DESY and HZB. It includes a new experimental Hall to double the number of user stations and an additional variable-gap undulator in a separate tunnel to be able to deliver two largely independent wavelengths to two different user stations simultaneously. The electron beam is switched between the present fixed-gap undulator line of FLASH (now referred to as FLASH I) and the new variable gap undulator FLASH II. The modification needed to the present facility is minor. Space for a total of at least five experimental stations is foreseen.

In addition to the SASE mode used in FLASH I, HHG seeding is foreseen for wavelengths between 10 nm and 40 nm. It uses a Ti:Sa laser at a repetition rate of 100 kHz, which is under development at DESY. For long wavelengths, SASE has to be used. At the smaller wavelength end, down to 10 nm, the seed power expected is still enough for sufficient seeding.

A study to extend the wavelength range down to 2 nm is in progress. The idea is to use a short afterburner optimized for this short wavelength at an energy of 1.25 GeV. In order to allow a variable polarization of the radiation pulses, this afterburner will be an APPLE III undulator. However, this wavelength can only be reached at reduced power, typically a few percent of the fundamental..



The construction of the Flash II extension buildings currently is under progress and is supported by our Survey & Alignmnet Group. We supplied the reference coordinates, staked out building axes and carried out various control surveys of sections already built.

HELMHOLTZ ASSOCIATION