Designing the Photon Beamline Frontends for the PETRAIII Extension Project

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Introduction

The photon beamline frontend designs for the new insertion device beamlines of the PETRAIII extension project [1] are presented. The designs are based on the original design concept developed for the photon beamline frontends at PETRAIII [2,3]. The aim of this generic approach was to minimize the number of specialized components for all beamlines. The existing girder concept allows a fast and reliable installation phase. The newly designed frontends aimed at using the same proven components and minimizing of the number of girder variations [4].

The new beamlines in the PETRAIII extension project are arranged in three new sector types in two additional buildings. There will be 4 new sectors with two undulator IDs in each sector (P22-P25, P62-P65). The canting angle between the undulators has been increased from 5mrad (PETRAIII) to 20mrad (PETRAIII Extension). Additionally, two of the straight sections are modified. One straight section will be transformed in a side station sector with a 1mrad canting angle (P21) [5]. The other straight section with the 40m long damping wiggler [6] will be used as a single beamline with a hard X-ray source (P61).

The major difference for the new generic approach was the change of the canting angle. Due to the adjustments to some components and the integration of additional components (e.g. water cooled CVD diamond screen) it was necessary to change the arrangement of the girders. Because of the different topology of the machine, the space in the tunnel and the crane system in the new halls the overall distance from the source to optic hutches grows from 30m up to more than 50m. The changes do not have a negative effect on the mask system and so most of the generic components could be used.

For the new side station beamline P21 a new mask system was necessary including a new beam splitting aperture. The aim of the design and the arrangement of all components was to use most of the generic components or only with as small and simple as possible modifications.

Installation Status

The buildings and the tunnel sections with the concrete shielding are completed. PETRAIII resumed user operation in the Max von Laue experimental hall in April 2015. Most of the generic 20mrad extension frontends are installed. The modified straight sections will be installed end of 2016 and in 2017. The work in the optic hutches and experimental hutches is continuing.

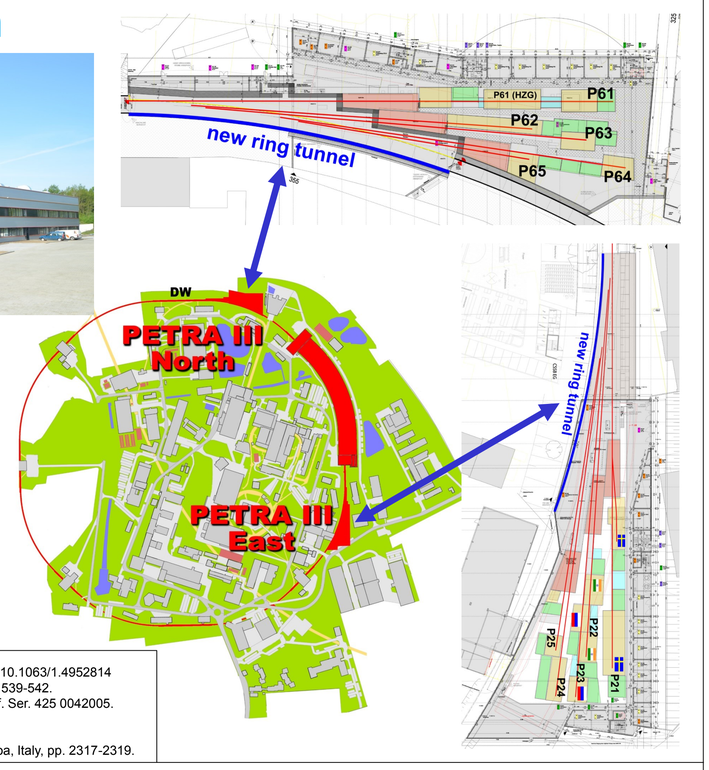
References

[1] W. Drube, M. Bieler, W.A. Caliebe, H. Schulte-Schrepping, J. Spengler, M. Tischer, R. Wanzenberg, "The PETRAIII extension", AIP Conf. Proc. 1741, 020035 (2016), 10.1063/1.4952814
[2] U. Hahn, H.B. Peters, R. Röhlsberger, H. Schulte-Schrepping, "The generic beamline concept of the PETRAIII undulator beamlines", AIP Conf. Proc. 879, (2006), pp. 539-542.
[3] M. Degenhardt, H.B. Peters, U. Hahn, J. Heuer, M. Hesse, H. Schulte-Schrepping, "Status of PETRAIII photon beamline frontends and optical systems", J.Phys.:Conf. Ser. 425 0042005.
[4] H. Schulte-Schrepping, et.al., "Photon beamline frontends for the PETRA III extension project", AIP Conf. Proc. 1741, 020041 (2016), 10.1063/1.4952820
[5] A. Schöps, P. Vagin, M. Tischer "Properties of the insertion devices for PETRA III and its extension", AIP Conf. Proc. 1741, 020019 (2016); 10.1063/1.4952798
[6] M. Tischer, K. Balewski, A. Batrakov, I. Ilyin, D. Shichkov, A. Utkin, P. Vagin, P. Vobly, "Damping Wigglers at the PETRAIII light source", Proceedings of EPAC08, Genoa, Italy, pp. 2317-2319.

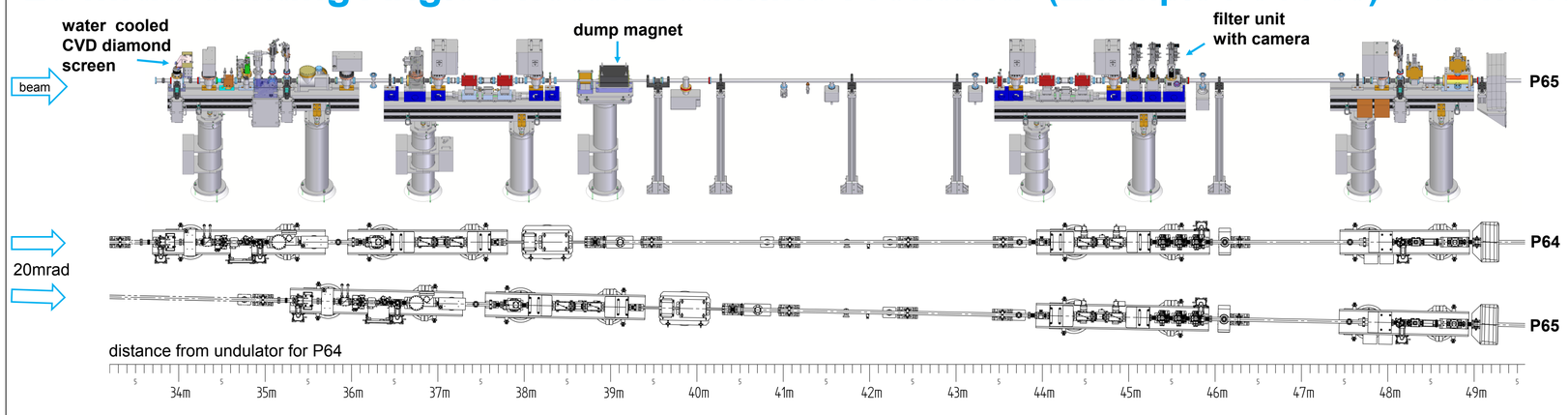
PETRAIII Extension

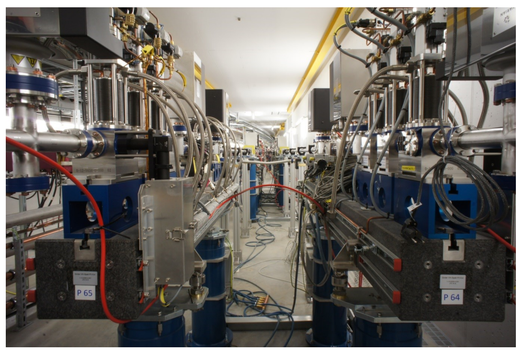
PETRAIII Hall North

PETRAIII Hall East



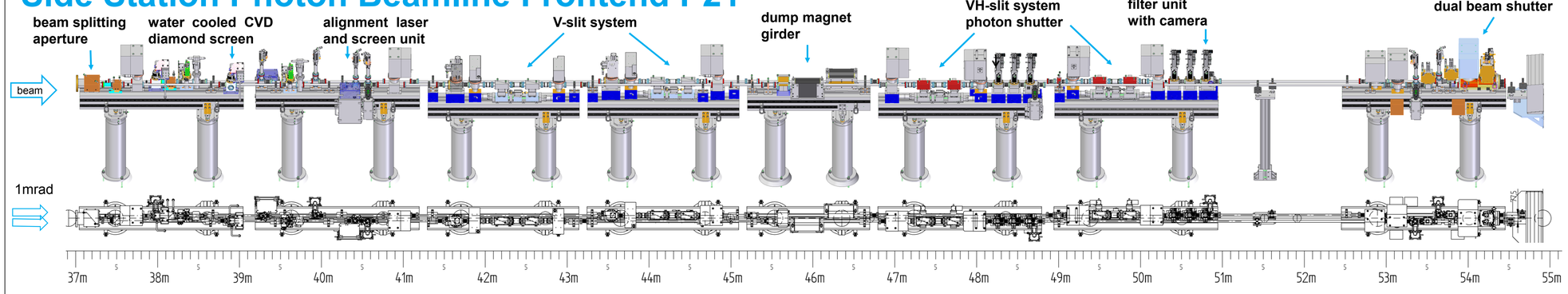
20 mrad Canting Angle Photon Beamline Frontend (Example P64/P65) – Generic PETRAIII Extension Frontend





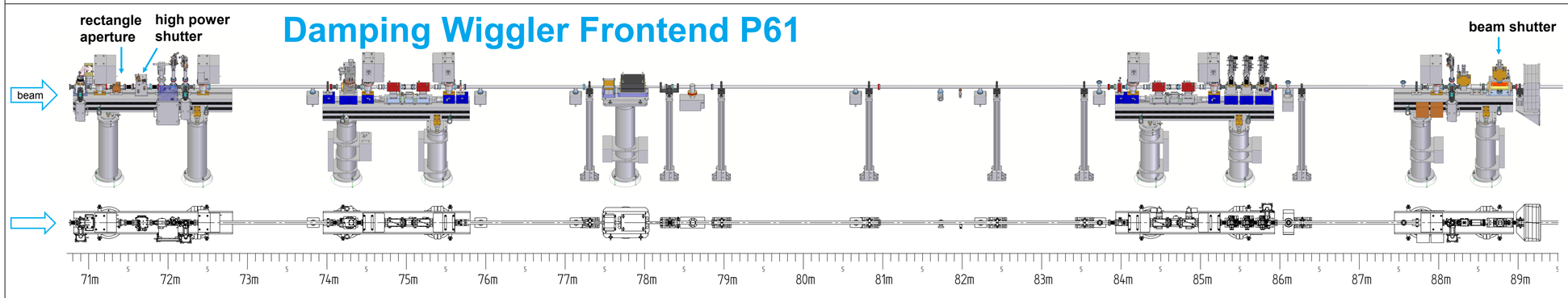
Upstream view from the filter system girder position into the P64/P65 frontend

Side Station Photon Beamline Frontend P21



The two beams in the side station beamline are seperated on the first girder in different tubes with a distance of 63mm. At the end of the frontend just before the 1,5m thick storage ring shielding wall the beamlines have a distance of 77,5mm. They shares a common vacuum system, which is seperated behind the shielding in the dual vacuum diagnostic unit.

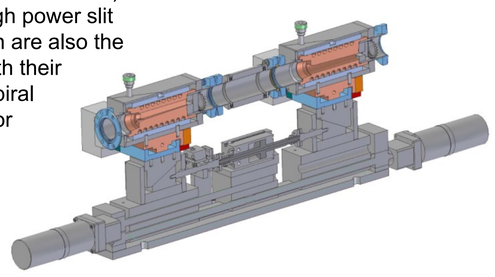
Damping Wiggler Frontend P61

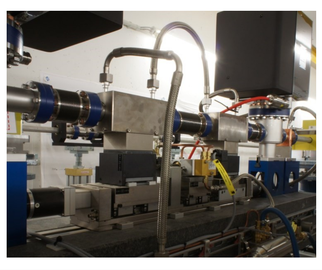


In the damping wiggler frontend the last three girders are the same as in the new generic frontend. Only the first girder features a new mask system consisting of the 3mm x 2mm rectangular aperture and a new high power shutter (both shown below) because of the fixed gap operations of the 40m long damping wiggler section.

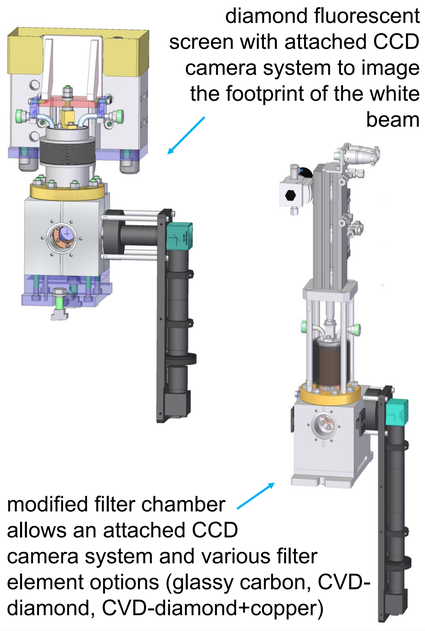
Special Frontend Components

VH (vertical and horizontal) white beam high power slit system. Shown are also the „slit blades" with their machined-in spiral as a channel for cooling water



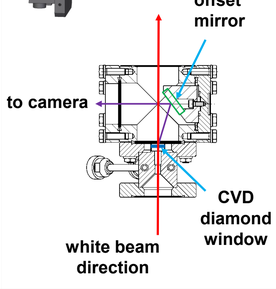


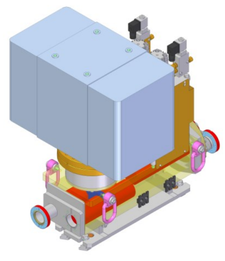
water cooled CVD-diamond fluorescent screen with attached CCD camera system to image the footprint of the white beam



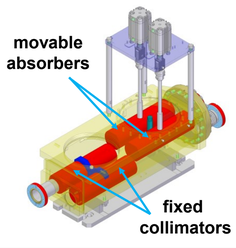
modified filter chamber allows an attached CCD camera system and various filter element options (glassy carbon, CVD-diamond, CVD-diamond+copper)

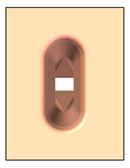
water cooled CVD-diamond window with attached offset mirror chamber and CCD camera system



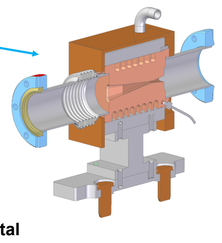


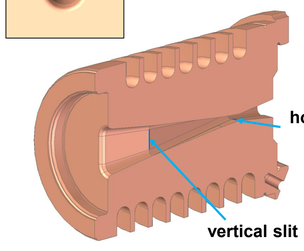
dual beam shutter for the side station frontend with fixed collimators and two independently movable absorbers

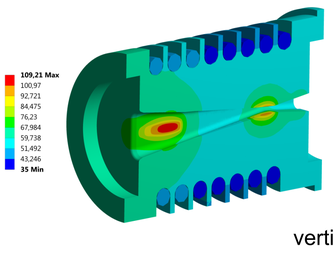


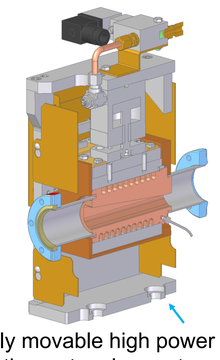


3mm x 2mm rectangular aperture with two in a row connected slits









vertically movable high power shutter just behind the rectangle aperture

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