



Mechanical Aspects of the New Shutter Design at European XFEL

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Introduction

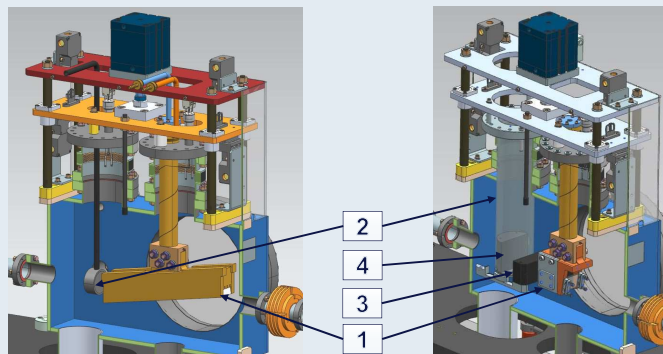
The European XFEL is a research facility which started operation in September 2017 and generates ultrashort X-ray flashes for photon science experiments with an outstanding peak brilliance.

To operate the facility at full performance, an upgrade of the radiation safety system is needed. For this purpose nine Frontends and three Shutters have to be modified. This upgrade includes several mechanical changes which are explained here.

Modification of Frontend and Shutters

The main changes of the upgrade of the Frontends and Shutters are the following and are shown in the pictures below (old design left, new design right):

- B4C absorber will be replaced by a diamond + B4C Absorber (1)
- New design of Burn-Through Monitor (2)
- Additional Burn-Through Monitor protection B4C block (3)
- Additional Graphite block (4)

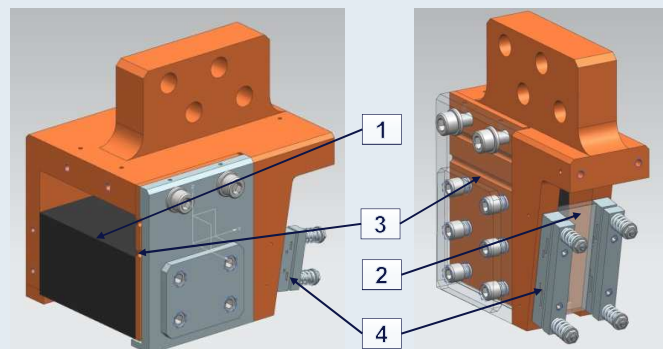


New Absorber Design

The new Absorber Design consists of

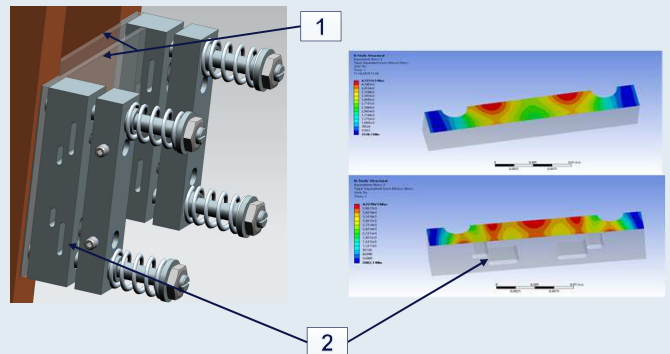
- B4C block (1)
- Additional diamond foils (2)

Due to space constraints in the chamber because of the new Burn-Through Monitor, Protection- and Graphite block the design has to be much smaller than the old one. The special flexure plate (3) guarantees a certain flexibility of the B4C and to release the stress on the Diamond a special CVD clamp system (4) has been designed.



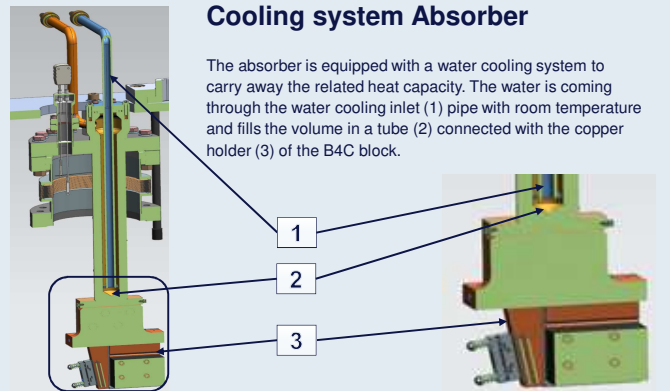
CVD clamp system

The special clamp system has to be created to release the stress on the diamond and avoid their destruction. It is attached on the water-cooled copper holder. The two Diamond foils (1) are clamped between a thin silver foil to have better contact to the holder and the clamping bars (left). With the additional cutting slots (2) the stress distribution gradient on the contact area improved more than 50% (right).



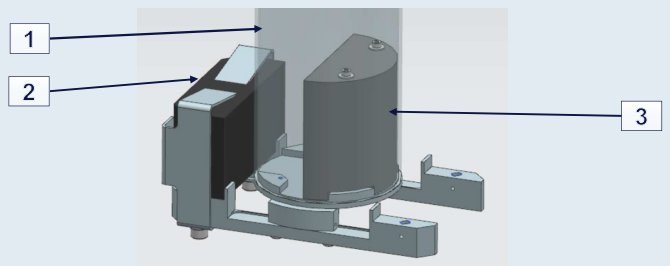
Cooling system Absorber

The absorber is equipped with a water cooling system to carry away the related heat capacity. The water is coming through the water cooling inlet (1) pipe with room temperature and fills the volume in a tube (2) connected with the copper holder (3) of the B4C block.



Burn-Through Monitor

The Burn-Through Monitor is a volume (1) filled with air and connected to the ambient atmosphere. If the absorber and the protection B4C block (2) fail and the beam burns a hole through this volume, a vacuum failure would be generated. The additional graphite block (3) in the tube gives some time until the fluorescence caused by the X-Ray beam in air triggers a stop of the injector.



References

- [1] H. Sinn: "Design of a Radiation Safety System for Full Beam Operation" (2019)
- [2] F. Yang: "Technical Specification for Front-End" (2013)