PSB-Beam Absorber – scraper after LS2

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ENGINEERING SPECIFICATION

PS BOOSTER BEAM ABSORBER/SCRAPER AFTER LS2

ABSTRACT:
This document summarizes the specifications for the design of a new PSB absorber within the LIU-PSB framework, which should replace the current main PSB aperture limitation, the so-called Window Beam Scope (WBS), installed in section 8L2.

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- Shall we keep the 0.9s repetition rate (time in between two cycles)?
- If not, can we update the specification?

PSB-Beam Absorber – scraper after LS2

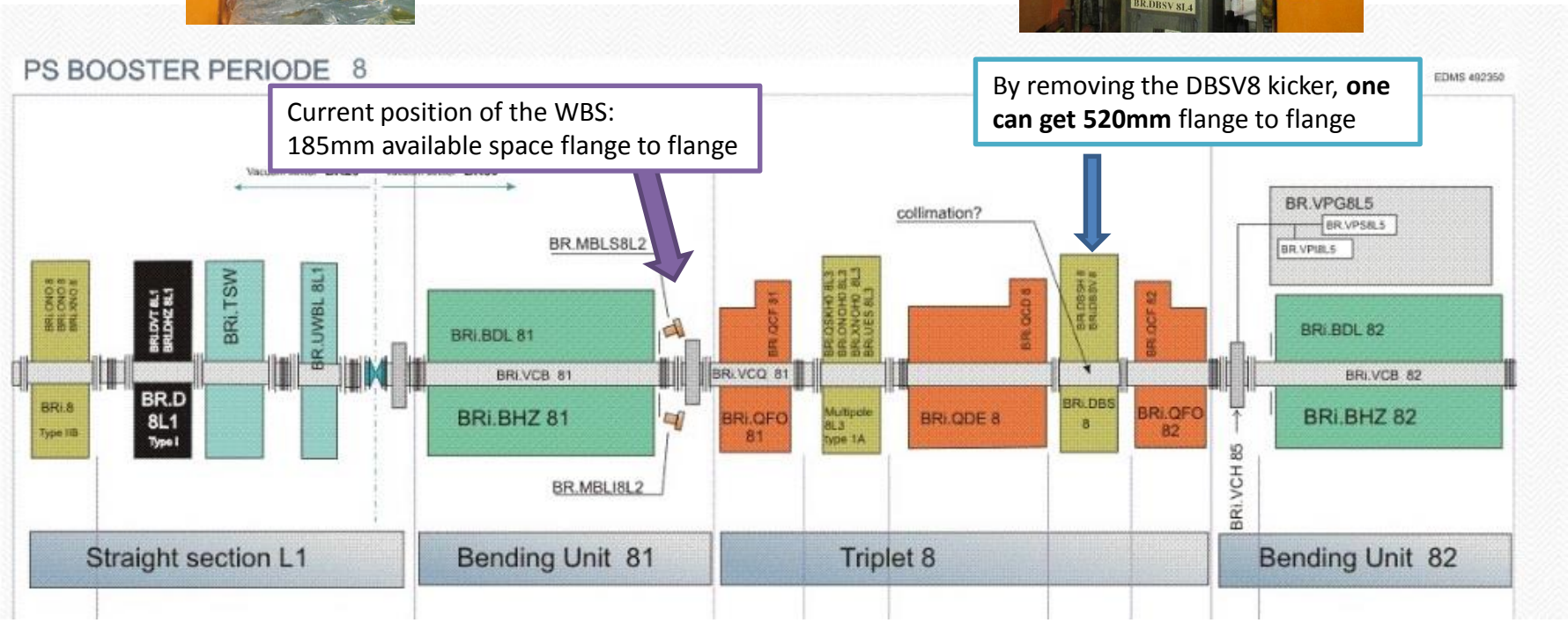
Status:

- Up to mid 2016: selection of the best target material.

Mechanical compatibility | RP compatibility | Vacuum compatibility

- By end of 2016 / beguining of 2017: Catia design of the mechanism, selection of the best technology for the linear movement.
- 2018: Equipment production and testing.
- Equipment delivery: LS2: end of 2019.

PSB-Beam Absorber – integration



B-Beam Absorber – Material mechanical analysis

PSB Upgrade
LIU Project

EN STI

THERMAL STUDY FOR PS BOOSTER ABSORBER

Boundary conditions

Beam definition

Energy: 160MeV (Bragg peak is reached)

Intensity: 2E13 p+

Pulse period: 0.9s

Geometry

For the core is GRAPHITE R4550 Polycrystalline SGL used with an estimated emissivity of 0.8. The aperture is a square shaped one with a corner length of 74mm in the center. The diameter of the cylindrical core is assumed with the dimension of 180 mm (s6) and a depth of 130 mm. The surface roughness is assumed with Ra=3.2.

For the Housing SS316L is assumed with an outer diameter of 200 mm and the emissivity of 0.38 (polished surface) as worst case. The inner diameter is the same like the one for the core but with the tolerance H7 and a roughness of Ra=1.6.

Simulation

Steady state is analyzed, so the Energy deposition per pulse is spread over 0.9 s. The heat is only dissipated via radiation of the surface. The body is assumed as completely surrounded by a cavity with a Temperature of 293.15 K.

Estimation of thermal contact

Between both bodies there is a thermal contact. The connection is assumed to be realized with a pressure fit. For the pressure fit there is a resulting difference in diameter between 33 µm and 108 µm, wich corresponds to an estimated average contact pressure between 0.875 MPa and 3.16 MPa between the bodies[1]. The estimated thermal transfer coefficient varies then between 1770 W/(m.K) and 5930 W/(m.K)[2].

[1] Calculated with: Wittel, H., et al. "Roloff Matek machine parts." *German: Roloff Matek Maschinenelemente), Springer Press, Munich, ISBN* (2013): 978-3658023263

[2] Calculated with: Marotta, E. E., and L. S. Fletcher. "Thermal contact conductance for aluminum and stainless-steel contacts." *Journal of thermophysics and heat transfer* 12.3 (1998): 374-381.

Modeled Geometry

The Geometry of the absorber part has two symmetry planes, which could be used for the FEM model. Due to the absence of one symmetry plane in the applied load, half of the geometry is modeled. The FLUKA binning has a size of approx. 0.3 mm in all three dimensions of space, and so the corresponding subpart is sized with 0.6 mm for the FE. The whole Mesh consists of 642k Elements, as seen in Figure 1.

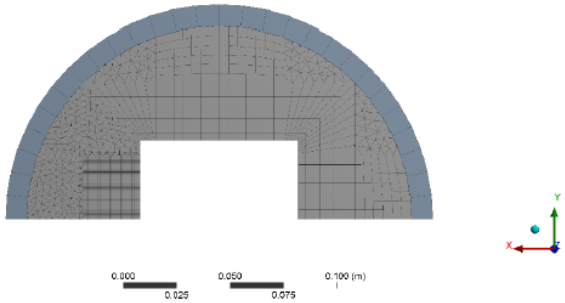
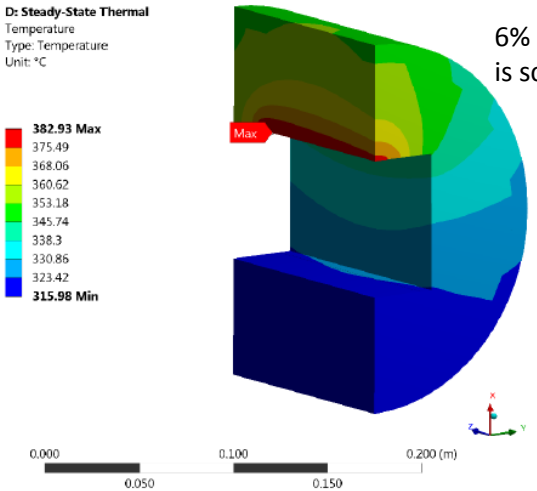


Figure 1: FE-Mesh

Results

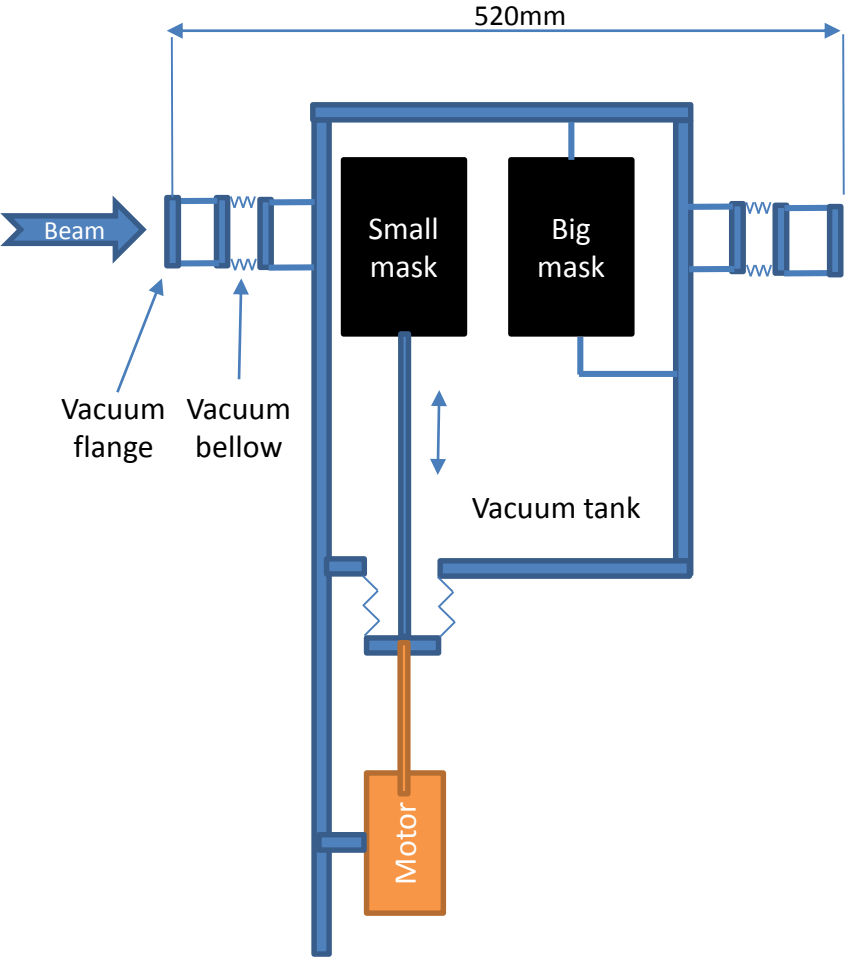
As seen in Figure 2 the resulting maximum of temperature is about 383°C in the core. The difference of temperature in the upper half of the body is less than 50K, so no high stresses are expected. Nevertheless a transient simulation of the dynamic themomechanic effects has to follow.

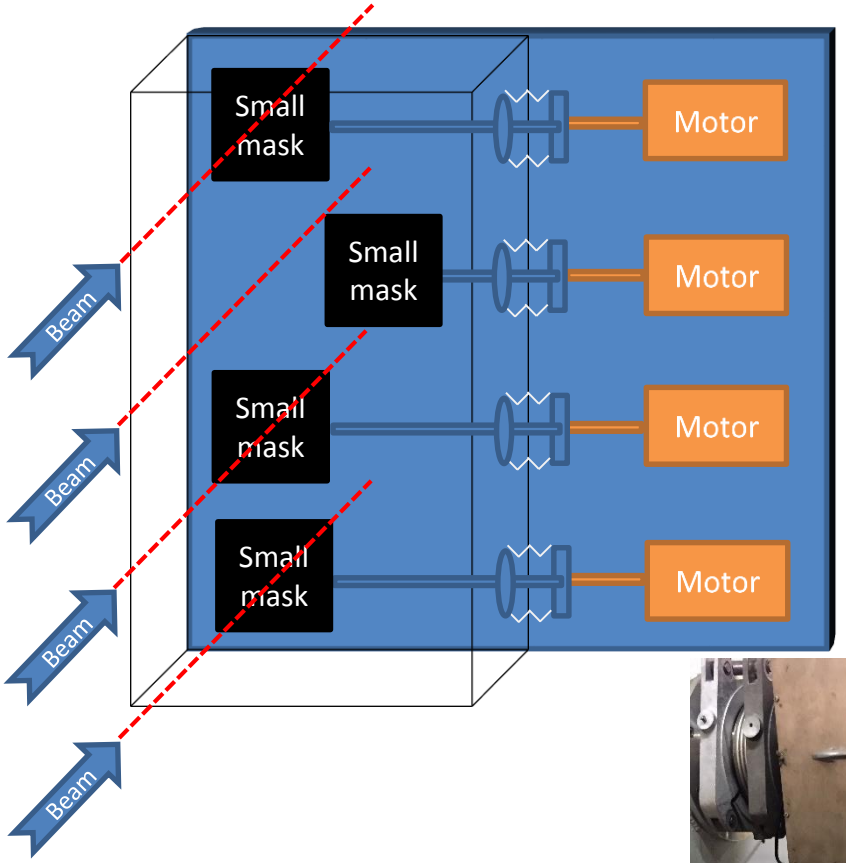


6% of the beam is scraped

PSB-Beam Absorber – foreseen design
Under discussion

TOP VIEW





Design similar to the BRBCW8L1