

PAUL SCHERRER INSTITUT 	Projekt / Project SLS 2.0
Titel / Title Appendix: “Heilige Liste” update	Dokument Nummer / Document Identification SLS2-SA81-005-APPX1
Autor(en) / Author(s) Masamitsu Aiba	Datum / Datee 13.01.2023
Zusammenfassung / Summary This document is an appendix to SLS2-SA81-005-31.xlsx and summarizes the changes made on the lattice after version B073/V31. The official HeiligeListe is SLS2-BJ84-100-nn.xlsx: nn=32, i.e. B073/V32 at the time when this documentation is created (18.11.2022). The changes will reflect to the new official list, which will be B074/V33. It is noted that there is no change in the lattice itself between B073/V31 and V32.	

Appendix 1: New lattice, version B074

The master layout files [1] of the present lattice, B073, are:

MasterLayout.B073_2022.06.23_Planned.txt

MasterLayout.B073_2022.06.23_Final.txt

for Phase-1 storage ring and Phase-2 storage ring, respectively.

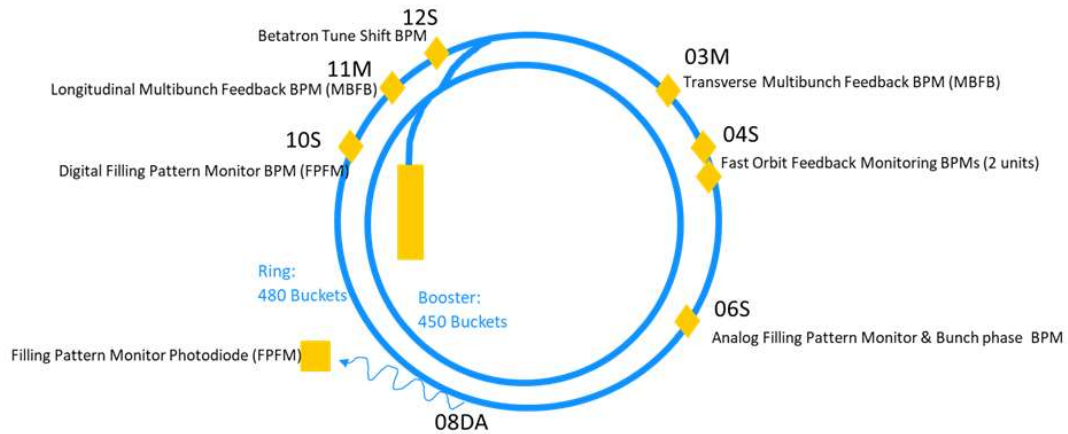
Based on these layouts, the following changes are implemented

- 1) Components in 1L straight section:
The emergency beam dump will be performed by a dedicated beam-dump kicker. It will be installed into 1L straight after the bump kicker, K1 and K2. This layout was selected to minimize the electron density at the beam dump (thick septum +x side) when the beam is dumped.
The short name for the beam-dump kicker is 'MKIK' as other kickers. The device type name is 'KBD'.
- 2) The reverse bending magnets, namely AN and ANM, were parallel to the neighbouring sextupole/octupole in B073 and older lattices. During the magnet cross-talk study, it turned out that the vertex points of these magnets shift longitudinally due to the fact that a constant curvature is employed in the hard-edge optics model whereas the actual magnets are designed as shifted straight quadrupoles, where the curvature is varying within the magnet. It is decided to rotate these magnets by halves of their bending angle, 0.12 deg and 0.13 deg for AN and ANM, respectively. This configuration approximately realizes a constant curvature.
The vertex point shift is not fully eliminated because of not only the approximation but also the cross-talk effect. It is under investigation if we need to shift these magnets longitudinally in addition to the rotation. This lattice update, however, includes only the rotation.
The optics slightly changes with the rotations and is re-matched.
- 3) It is requested to shift the quadrupole doublet in 11M straight section by 300 mm downstream ideally or at least 250 mm in order to make the space for insertion device longer.
It turned out that such a shift pushes the quadrupole strength of the doublet to the limit (QP, 93 T/m). Slightly more distance between the quadrupoles helps to keep the quadrupole strength below the limit with some margin. Therefore, the doublet is shifted by 250 mm, and the distance between the quadrupoles are increased by 30 mm, resulting a 280-mm-shorter straight section for the longitudinal FOFB kicker, which is installed into the second straight section of 11M.
- 4) The BPM-CHV unit is installed upstream of each LGB magnet, including the half LGB of the dispersion suppressor. The downstream of LGB is reserved for the synchrotron radiation absorber.
However, an additional BPM after the end of each arc (downstream of the half LGB) may be helpful for the dispersion measurement and correction. These additional BPMs were included in OPA file, where the lattice was developed, whereas they did not appear in the master layout files. Therefore, they are missing in the holy list while the 3D model already includes them as vacuum components (BPM buttons are integrated into the vacuum chamber). These BPMs are incorporated in this lattice update properly, i.e. included in the holy list. The distance between the BPM and the octupole of the neighbouring SOQ unit is 57 mm in OPA file while it is 49.1 mm in the 3D model. The latter value is used since the chamber design has been already completed.
A technical problem arises due to the additional BPM: each component has entries for Length and 'Reserve length' in the master layout file. For instance, the electromagnet iron core length corresponds to Length entry and the space for the coil Reserved length. The Length and Reserved length of the octupole are 50 mm and 15 mm, respectively, and for the BPM 0 mm and 12.5 mm. Therefore, the octupole overlaps with the additional BPM ($50/2+15+12.5=52.5 \text{ mm} > 49.1 \text{ mm}$). We decide to decrease Reserve length of BPM from 12.5 mm to 4.5 mm (not for BPMY). In the holy list, the length of the component is $L+2RL$.

- 5) It is planned to install more BPMs into the straight sections to meet various needs. Table below summarizes the BPMs to be added (orange highlighted) in the straight sections. (The positions of these BPMs are tentative and to be fixed in the next update, which is foreseen in a few months.)

Name	Type	MidPos[mm]
ARS01-DBPM-0400	BPMY	5069
ARS01-DBPM-0580	BPMY	7265
ARS01-DBPM-0810	BPMY	10185
ARS03-DBPM-0840	BPM	56395.44
ARS03-DBPM-0810	BPM	56265.14
ARS04-DBPM-0020	BPM	74760.14
ARS04-DBPM-0980	BPM	78695.14
ARS05-DBPM-0410	BPM	101205.14
ARS07-DBPM-0810	BPM	152265.155
ARS09-DBPM-0570	BPM	199205.155
ARS10-DBPM-0950	BPM	225676.955
ARS11-DBPM-0880	BPM	248645.47
ARS11-DBPM-0850	BPM	248515.17
ARS12-DBPM-0950	BPM	270595.17

The MidPos values are for Phase-2 lattice, which are slightly different from those of Phase-1 because of Superbends.



- 6) The plan of 5L undulators is still under discussion. In B073 lattice, U70 and a pair of UE36s are installed in Phase2 of B073. They are removed by this update.

With these changes, new layout files are:

MasterLayout.B074_2022.12.23_Planned.txt

MasterLayout.B074_2022.12.23_Final.txt

Reference

[1] SLS2-AM81-004-1, “SLS 2.0 Layout Management”