

Remove and replace magnets to install a new beam collimator

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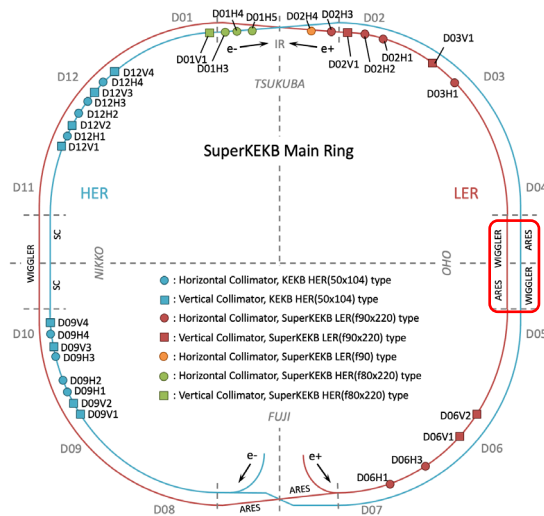
SuperKEK is an electron-positron collider that achieves a luminosity far exceeding that of its predecessor, KEKB, for exploring new physics beyond the Standard Model[1]. The main ring(MR) of SuperKEKB consists of a 7 GeV electron ring(HER) and a 4 GeV positron ring(LER)[2]. Table 1 shows the design parameters and the values achieved on the last day of the RUN2022ab (from Feb. 21 to Jun. 22, 2022) at SuperKEKB.

SuperKEKB surpasses the luminosity record of KEKB and continues to break the world's highest luminosity value. However, achieving a luminosity more than ten times higher for future operations is necessary. To achieve this goal, SuperKEKB requires further squeezing of the vertical beam size at the IP and storage of higher beam currents, as shown in Table 1. In this process, one of the critical issues is the increase in the beam-induced background(BG) in particle detectors(Belle II)[3]. Collimators were installed in SuperKEKB to mitigate the BGs and ensure the stable and safe operation of Belle II. Another major issue related to collimators is the phenomenon, caused by some unknown reason, of beam hit and damage to the collimators. Damaged collimators were observed to have a reduced BG reduction capacity and increased impedance. We, therefore, decided to install a new collimator, called a non-linear collimator (NLC), within the Wigger magnet section. This poster describes the removal of the wiggler magnets, the relocation of the quadrupole magnets, and the installation of new power supplies for them, which were carried out in conjunction with the installation of the NLC.

[1] Z. Dolezal and S. Uno, Belle II Technical Design Report KEK Report 2010-1, October 2010, H (2010) <https://www.superkekb.kek.jp/documents/B2TDR.pdf>.
[2] Y. Ohnishi et al., Accelerator design at SuperKEKB, PTEP 2013, 03A011 (2013).
[3] A. Natchii, T. Browder, L. Cao, K. Kojima, D. Liventsev, F. Meier, K. Nakamura, H. Nakayama, C. Niebuhr, A. Novosel, et al., Beam background expectations for belle ii at superkekb, arXiv preprint arXiv:2203.05731 (2022).

Table 1

Parameters	Design		RUN2022ab	
	LER	HER	LER	HER
Beam currents (A)	3.6	2.6	1.46	1.14
Energy (GeV)	4.0	7.0	4.0	7.0
Number of bunches	2500		2249	
Bunch current (mA)	1.44	1.04	0.65	0.507
β_x^* / β_y^* (mm)	32/0.27	25/0.30	80/1.00	60/1.00
Luminosity ($10^{34} \text{ cm}^{-2}\text{s}^{-1}$)	80		4365	

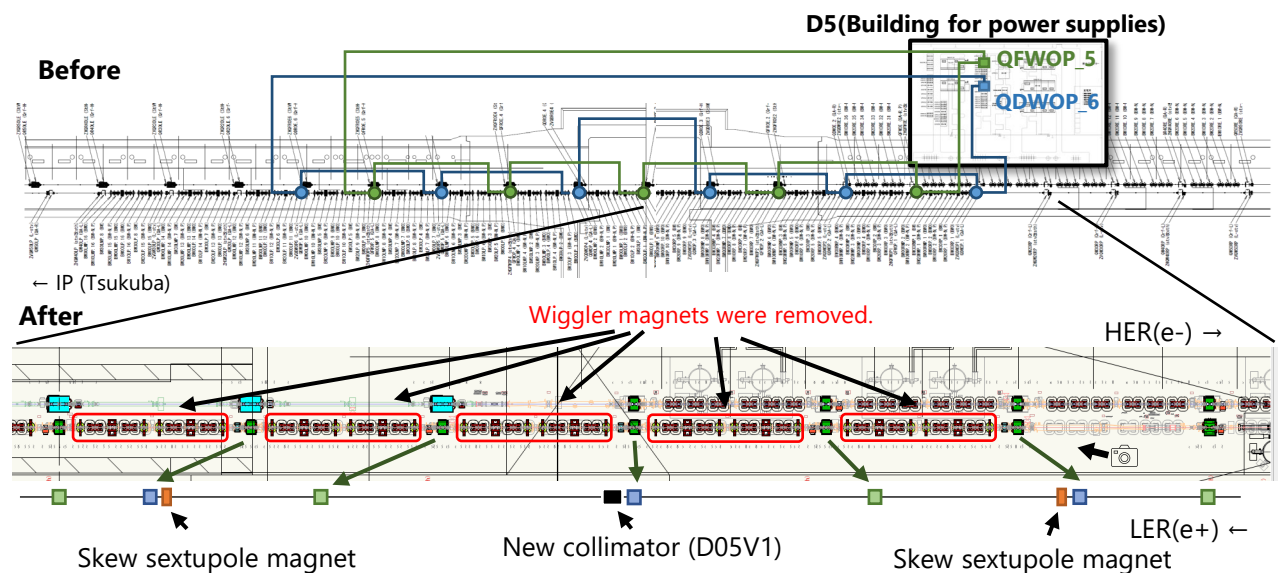
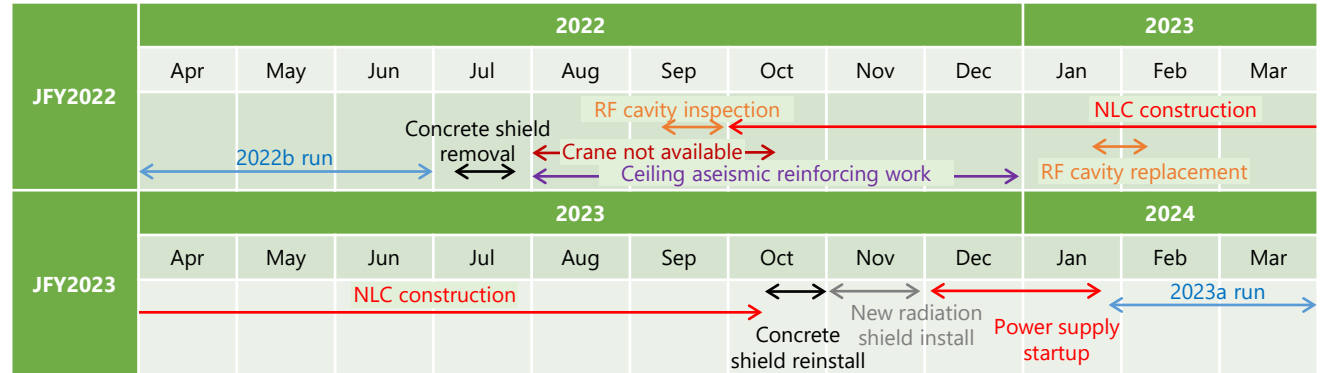


Existing collimators and NLC installation

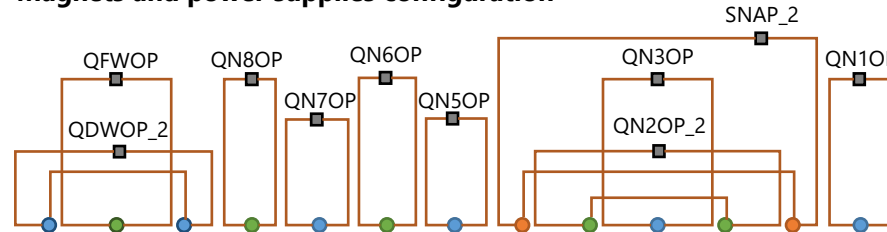
Wiggler magnets and beam pipe removal

- Removed wiggler magnet and cable.
50 magnets and their cables
 - Double pole magnet (3 ton) : 20
 - Single pole magnet (2 ton) : 10
 - Half pole magnet (1.5 ton) : 20
 - Cables : 3 ton
- Removed beam pipe for wiggler magnet.
- Disassembly procedure.
 - Removal of wiggler magnet cables
 - Upper parts of wiggler magnets disassembly
 - Beam pipe removal
 - Upper parts of wiggler magnets reassembly
 - Wiggler magnets removal
- Power cable extension and reconnection.
- Reconditioning of the power supply for the wiggler magnets

10 times



Magnets and power supplies configuration



Q & steering magnets relocation & Skew sextupole magnets installation

- Magnets installation and alignment.
 - New or extended base plate
 - Machining magnetic mounts
- Connect the cooling water pipes.
 - Moving the cooling water carrier pipe
 - Prepare longer flexible hoses
- Wiring and connecting new power cables and interlock-signal cables.
 - Power cable: 400 ~ 500 sq, a few 100m from each power supply

New collimator(NLC) installation Beam pipe installation

- Power supplies for Q and Skew sextupole magnets
 - Two of the ten units reuse existing power supplies.
 - The remaining eight, which were left as spare parts machines, are installed.

Due to the COVID-19 disaster and other factors, components were not procured in time for the production of new power supplies.

The new power supplies, which were initially planned to be installed, will be installed during this yearly shutdown.

This work hasn't finished yet.

