



1

SuperKEKB schedule

Kazunori AKAI Accelerator Laboratory, KEK

Mar. 14, 2018 @KEKB review



K. AKAI, SuperKEKB schedule, Mar. 14, 2018 @KEKB review

higher beam currents



Overall schedule







SuperKEKB operation schedule





History of Phase 2 start change

- As of Jan. 2016
 - Based on JFY2016 budget allocation, Phase 2 start was shifted from June to October 2017. (previous page)
- As of summer winter 2016
 - Due to production delay in Belle II, some of installation work were moved to after Belle II roll-in, originally scheduled before the roll-in. This required four more months after the roll-in.
 - QCSR delivery delayed due to several problems during fabrication process at company.
 - These issues shifted Phase 2 start from Oct. 2017 to mid-Feb. 2018.
 - The JFY2017 budget allocation, announced in Dec. 2016, turned out to be compatible with the new plan. <u>(next page, upper)</u>
- As of Sep. 2017
 - An interference problem on piping and cabling occurred in very tight space during Belle-II installation work. It took a half month to repair it, which shifted Phase 2 start from mid-Feb. to early Mar. 2018.
- As of Feb. 2018
 - An water leak problem occured in a beam pipe cooling channel close to the IP. We decided to take temporary measure which needs two weeks work, instead of to access and repair, which would require 7 weeks.
 - The ongoing schedule is to start BT tuning on 16 March and HER tuning on 19 March. <u>(next page, lower)</u>

(C) IR-related schedule change in 201

Schedule plan as of Feb. 2017 (shown at BPAC)





QCS installed in IR





Photo taken in March 2017.



QCS field measurement



- Cool down test and field measurement of QCS was successfully completed by the end of August, as scheduled.
- No serious issue for Phase 2 was found from measured data.





IR work in autumn 2017



Sep. – Dec. 2017

- During this period Belle II group works for installation • of detectors, cabling, piping, etc. was conducted.
- In parallel with Belle II group works, accelerator group work was conducted.
 - Cooling efficiency of current leads at QCS service boxes was improved.
 - Beam pipes in QCS were changed from those used for magnetic field measurement to those for Phase 2 operation.
 - Short beam pipes with BPMs and bellows were attached to the IP chamber. --> Talk by K. Kanazawa
- Belle II works completed at the end of December.
 - Subsequently, accelerator group work resumed in January, including QCS move-in, restoring IR components, etc.



QCS - Belle II connection



K. Kanazawa, @B2GM, Feb. 5, 2018





Photo by I. Nakamura







Final work befor Phase 2







All magnets are re-installed and all beam pipes are connected. Cabling and other works finished.



Final work: Set new concrete shields to IP. This will be completed by Mar. 14.

K. Kanazawa, @B2GM, Feb. 5, 2018



Improvements in MR other than IR

Y. Suetsugu, et al.

- Injection part change
 - New septum and beam pipes to accommodate the new positron injection scheme with DR were installed.
 - LER abort system including kicker magnets was upgraded to tolerate higher beam current with a smaller beam size.
- Collimators added around Tsukuba straight section
 - Based on good performance confirmed during Phase 1, mass production was conducted for Phase 2.
 - Six new collimators (two V-type ones and four H-type ones) have been added to meet requirements for Phase 2 operation.
- More mitigation for e-cloud
 - Apply permanent magnets to beam pipes at drift spaces, etc. for higher beam current in Phase 2 completed.

Permanent magnets at drift space



K. AKAI, SuperKEKB schedule, Mar. 14, 2018 @KEKB review

Vertical type collimator (D02_V1)



New septum for injection region





Beam Instrumentation

Install QC1 orbit detectors for IP orbit feedback.

- Resolution <1 μm with feedback bandwidth < 100 Hz
- Integrate CCC, Dithering FB and Beam-beam kick based FB

- Add 20+ Gated turn-by-turn monitors
 - 117 (existing) + 22 (new)
 - Inside QCS cryostat, Near injection point, Near beam collimators

XRM beam size monitors

- Deep Si pixel detector and spectrometer (SLAC) and 128-ch fast readout systems (Hawaii)
- Increase β y of HER source point for better resolution.
- LABM (Wayne State Univ.)
 - Start measure real beamstrahlung





M. Tobiyama



13





Other work in MR for Phase 2

- Appropriate maintenance and improvements of a number of accelerator components for higher reliability and higher performance, in particular:
 - power supplies for magnets,
 - magnet alignment,
 - high power RF components and RF cavities
 - cooling systems,
 - control systems, etc.
- Development of tools needed for phase 2 commissioning.
 - operation software,
 - timing control system, etc.
- Modification of safety system
 - to manage new DR and PF-AR direct injection systems.

Damping Ring Complex N. lida, @B2GM, Feb. 5, 2018

Super KEKB

The DR damps the emittance of the e+ beam to inject into the LER.

The positron beam from Flux Concentrator(FC) has a huge longitudinal distribution.

LTR: The energy spread(5%) should be reduced within the energy acceptance of the DR(1.5%) with the Energy Compression System(ECS) in the LTR.

RTL: The bunch length extracted from the DR(6.7mm) should be shortened(0.65mm) to fit the LINAC S-band system with the Bunch Compression System (BCS) in the RTL.





DR construction completed

H. Sugimoto, Promotion Committee of B Factory, Jan. 31, 2018





More photos for the DR







K. AKAI, SuperKEKB schedule, Mar. 14, 2018 @KEKB review



RF cavities

Ext. septum



DR commissioning



- LTR beam tuning started on Jan. 23, 2018.
 - Major study items for LTR completed by Feb. 7.
- DR beam tuning started on Feb. 8.
- Rough plan of DR beam tuning:
 - DR Injection+DR rough tuning: 2-3 days
 - DR Extraction+RTL+LINAC Tuning(Rough): 2-3 days
 - DR + RTL Fine Tuning: 2 weeks
 - The vacuum scrubbing needs:
 - About 5 days x 3 shifts for 0.5nC/bunch, 4bunch.
- Injection to LER via DR
 - Beam injection to LER via DR is needed in late March.
 - The DR commissioning plan and ongoing status meet the requirement.
 --> Talks by N. lida (LTR/RTL) and H. Sugimoto (DR)

--> Talks by K. Furukawa and Linac members (Linac)







Major purposes of Phase 2

- --> Talk by Y. Ohnishi
- To verify Nano-Beam collision scheme by achieving expected luminosity.
- To study beam background and judge if Vertex Detector (VXD) can be installed in Belle II for Phase 3.
- Term of Phase 2
 - Will start soon:
 - BT tuning starts on March 16.
 - HER tuning starts on March 19.
 - LER tuning follows.
 - Will continue until July 17.
 - Limited by high pressure gas regulation and power cut scheduled in August.
 - To complete phase 2 by summer is very important: otherwise Phase 3 start will be significantly delayed.



Phase 2 to 3 transition



- Transition work to Phase 3 will start after Phase 2 completed on July 17, 2018.
- Working contents:
 - Dismantle IR accelerator components. (Accelerator Gr.)
 - Belle II group work for VXD installation, etc. (Belle II Gr.)
 - Restore IR accelerator components. (Accelerator Gr.)
- Term of work
 - Depends on working contents for Belle II.
 - (Term for accelerator-related work can be estimated from our experience to prepare for Phase 1 and 2.)
 - In the last B2GM held on Feb. 5 it was agreed btw accelerator and Belle II to aim at starting Phase 3 in February 2019.

Current status and plan for 2018









- Renovation work for SuperKEKB Phase 2 will complete this week. (by 15 March, 2018)
 - MR phase 2 commissioning will start in mid-March.
- DR construction completed and test operation started.
 - Beam tuning of LTR and DR started in Jan. 23 and Feb. 8, respectively.
 - It is expected that injection to LER via DR will be ready when it is needed (late March).
- JFY2018 schedule is being solidified.
 - Phase 2 operation will continue until July 17, 2018.
 - After Phase 2 to 3 transition work completed, Phase 3 operation will start (target is Feb. 2019).