

SuperKEKB Domestic Review

September 8, 2017 @ KEK

Preface

A number of detailed and frank presentations were made on several parts of SuperKEKB. SuperKEKB is the largest project at KEK Tsukuba to be completed not only by the effort of each dedicated group, but with the total strengths of KEK. Such a large project consists of a wide variety of sub-components both in the rings and the injectors, thus the ceaseless communication and scientific discussion among them are absolutely unavoidable. Such a domestic review as this time can provide such a opportunity.

Project overview

Comments:

- An optimized plan of the entire project including the Belle-II detector is necessary.
- The necessary condition other than the luminosity for the transition from Phase II to Phase III should be identified, including the establishment of the collision and the level of the detector background, etc. A common understanding with Belle-II is necessary.
- A time line for the injector performance improvement through Phase II & III must be produced.

Positron source

Comments:

- The exchange of the flux concentrator(FC) should be done regularly even without damage to reduce the radiation exposure.
- Reconsidering the material of the FC can be necessary. Review the material choice by reevaluating the data in the past.
- A coil with a larger gap width may be possible.
- This time the FC caused discharging after installing into the tunnel, despite the success in the tests on surface. The actual pulse form could differ between them.
- The conditioning should be performed at a voltage higher than the spec by 20%.
- It is important to know whether the discharge at the large aperture S band (LAS) structure was due to the placement nearby the positron source.
- The validness of “hardening” needs more investigation including on the diagnostics. Did it really improved the entire elasticity or just for the surface?
- The estimated improvement on the amount of charge is 20% by increasing the voltage from 6kV to 12 kV. Consider the priority of the higher voltage plan taking the necessary resources and the effect.
- Even a non-FC schemes such as at previous KEKB is thinkable.

Recommendation:

- Establish an interlock system against discharging to stop operation in a single pulse to prevent a fatal damage.

RF gun

Comments:

- It has been surfaced that a large blowup of the effective emittance due to beam jitter through the linac, which is not originated from the RF gun. An immediate measure for this issue must be taken over the observation, identification of the cause, and allocation of Human Resources.
- The thermionic gun needs care for maintenance and repair.
- The quantum efficiency of the IrCe cathode reached 10^{-4} only at the test bench, not after installed to the gun, due to the actual vacuum condition in the gun. Further investigation is necessary for the QTW gun.
- How much margin is there for the laser power? Does the amplification by Nd solid amplifier keep the quality and stability at the high power?
- The operation stability in a long time span continues to be the issue.
- The remaining burden for pulse-shaping, which has been said to be necessary for Phase III, seems nontrivial. Further investigations and reviews are necessary.
- A prioritization of the work should be done by the entire injector group to maximize the integrated luminosity.

Recommendations:

- A tendency is seen to employ a new technology or to replace existing schemes, before detailed analysis of present achievements with deep discussion and information exchange by broad members including other projects.
- Considering the critical role of the RF gun in the entire project, it is necessary to separate the operation from developments by sticking to an existing technology as far as possible.

Accelerating structure

Comments:

- The replacement of aged accelerating structures must be planned persistently considering the allowable budget and resources.
- The energy gain per unit may be increased by the new replacement structures. Thus the locations of such new structures should be optimized. The maximum achievable energy can be increased by rearrangement of good structures over the linac.
- There are variations in the output power of the klystrons, even under a constant $E_s = 42$ kV. The reachable energy should take this into account.
- It is important to establish strategies to identify wrong structures, the necessary time to replace them, and reliability of the diagnosis. Also the maximum usable period of good structures should be defined.

Pulse magnets in the linac

Comments:

- The performance and stability of the timing system is a key for the pulsed magnets. The allocation of resources on this subject seems weak compared to its expected role. It should be solved by involving the entire linac control group and ring people.
- The hardware of the pulsed magnets seems more or less completed.
- A overall test is urgent to check the synchronization of all 66 pulsed magnets.

- Recalibration will be necessary at each time to replace a broken magnet. A protocol is needed for such replacement and recalibration. It is important to ensure enough startup time for such a replacement. The calibration must be confirmed by the beam.
- The remaining issues including the stability at low currents, repeatability of the field, a long-term durability must be presumed within a month from now.

Timing system for Damping Ring

Comments:

- Make clear the time line and milestones from TRL3 to TRL9. The scheduling is necessary.
- An integrated environment covering both linac and rings will be necessarily.
- The requirements for the injection/extraction should be reconfirmed.
- The timing system will be common for operations of Photon Factory and PF-AR.

QCS

Comments:

- The field measurement has assured the validity of the design even with the hysteresis of the ferromagnetic shields. The field measurement of higher order components has been improved by canceling the main component by a backing coil.
- No fatal issue has been seen on the preparation of QCS system.
- The lifetime of the cryogenics inherited since TRISTAN needs attention.
- Examine whether the measured sextuplets components are explained by the fringe field of the solenoid.
- The measured longitudinal shift of these magnets should be reflected to the optics model.

Luminosity tuning

Comments:

- Although experiences at PEP-II, the dithering method is new to KEK. An intensive beam study must be carried quite through Phase II operation, by comparing to the design and simulations.
- The system for the luminometer and dithering involves components mainly developed by foreign labs. The beam studies must be arranged to ensure the involvement of such foreign researchers.
- It is important to evaluate the tolerance of the imbalance of the bunch intensity between two beams considering the flip-flop effect.
- It may be worth extending the collaboration with LAL further beyond the fast luminometer.
- How is the collaboration with INFN going?

Electron cloud

Comments:

- The mechanism of the generation of e-cloud has been well understood theoretically and by simulations, to be consistent with measurements done at Phase I. The planned mitigation methods are rational and expected to work properly.

Machine-detector interface (MDI)

Comments:

- The sources of detector background critical at Phase III must be fully understood at Phase II.
- The commissioning must be done efficiently, by ensuring tight communication between the machine and detector groups. Necessary software and hardware must be ready in time, including the interlock system.
- It may be fruitful for both optics and background studies to challenge squeezing the beam down to the design of Phase III values, even for a single beam.
- a simulation study for the scattered particles from the collimators to the detector,
- Understanding of the losing particles at the injection is important.
- Evaluate the effects on the detector by the misalignments if QCS.

Concerning the overall project

Comments:

- The amount of charge from the RF gun and the positron source can stay 1/2 of the design for the first a few years. The top up injection may relax the requirement further. In this sense the priority should be put more on stability and operability of existing schemes than new challenges, at least for the first a few years.
- The budget and resources are extremely short. However some maldistribution of resources may have been observed, making too light the existing technologies.
- The project has been going on without publishing the design report. This should be done immediately.
- More flexible schemes to obtain new people with operation budget should be perused, under necessary supports by KEK.
- Extend international collaboration by overcoming several apparent obstacles. They will return eventually.
- The experiment at 6S can be unique in the world and may bring attention.
- It is important to ensure a smooth transition between generations, since this project will need a very long period of time toward the completions the goal. It is very important to keep and enlarge the motivations for SuoerKEKB by all members of the project, through everyday's scientific communication and discussions.

Date & time : Sept. 8, 2017, 9:00 - 19:00

Program: <http://accphys.kek.jp/indico/conferenceDisplay.py?confId=122>

Reviewers: A Enomoto, J. Haba, K. Harada, Y. Honda, S. Michizono, F. Naito, T. Nakata, K. Oide(Chair), K. Satoh,