



Staff Exchange



KEK Inter-University Research Institute Corporation
High Energy Accelerator Research Organization

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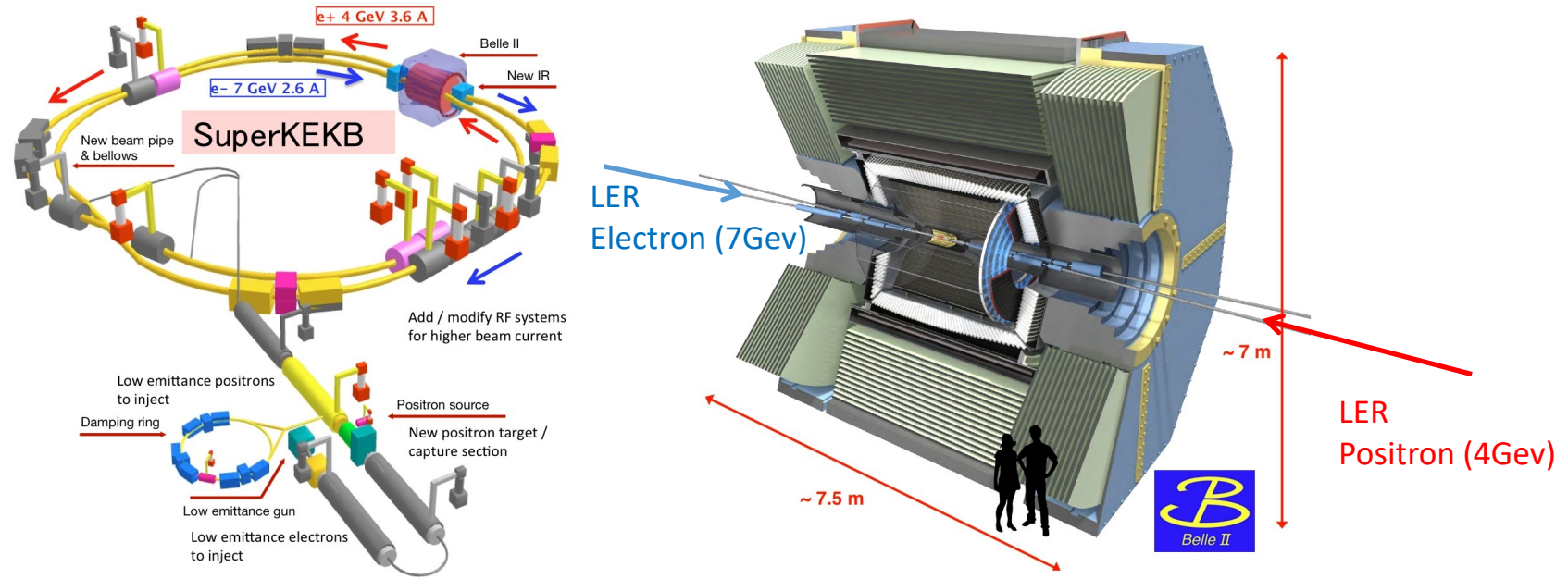
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Mechanics of IP region at Belle II



This project is linked to the VXD upgrade proposal of Belle II (see talk of M. Yamada)

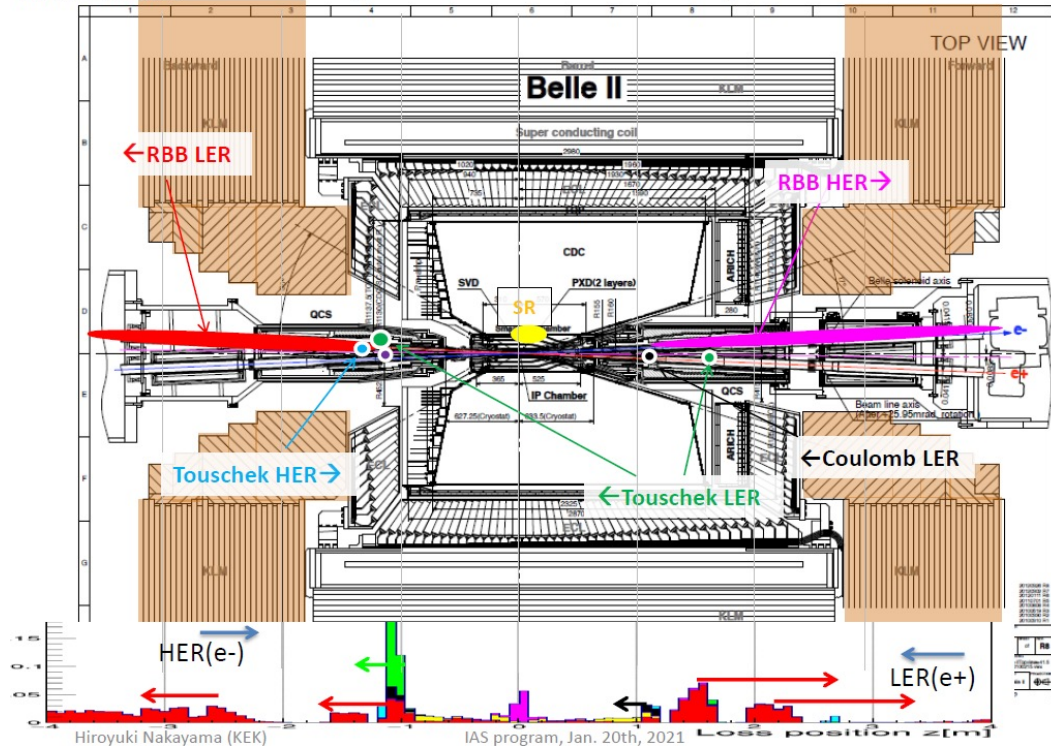
- Introduction
- Project for 2023
- Team contribution
- Long term
- Demand



SuperKEKB : A Very high luminosity electron-positron collider.
Innovative beam optics near the IP (Interaction Point) : Concept of high intensity nano-beams.
 for
 Study of fundamental properties of heavy quarks.
 Quest for underlying BSM physics.

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Background Global picture



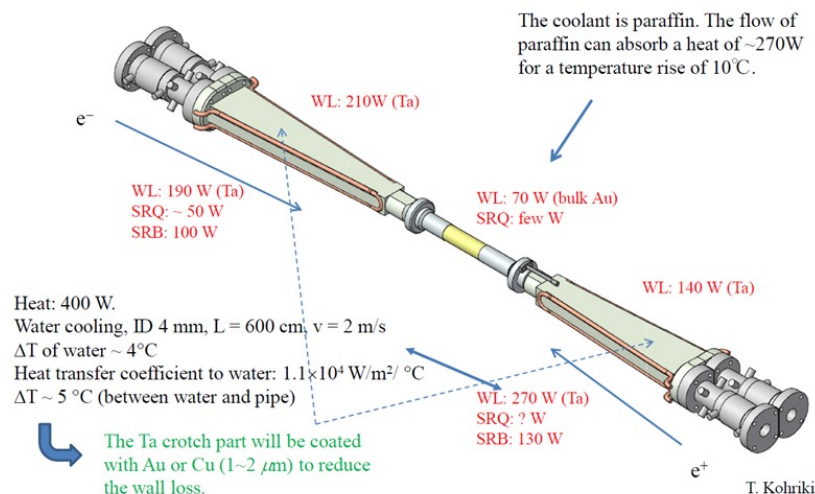
The goal of the partnership is to build up a comprehensive understanding of the mechanics of the beam pipe elements in the vicinity of the IP.

Foresee and prevent the consequences of the progressive ramping up of the luminosity on the IP environment.

Opportunities to update the IP region mechanics are limited to long-term shutdowns. The first one will start in summer 2023, while the next one is scheduled for 2027.

The acquired expertise and skills through this partnership can be further applied to future experiments, such as at a Higgs factory (e.g. ILC).

On Heat load



Japanese and french teams combined skills :

- IP region Belle 2 knowledge
- Accelerator physics
- FEM analysis
- CAD and mechanics

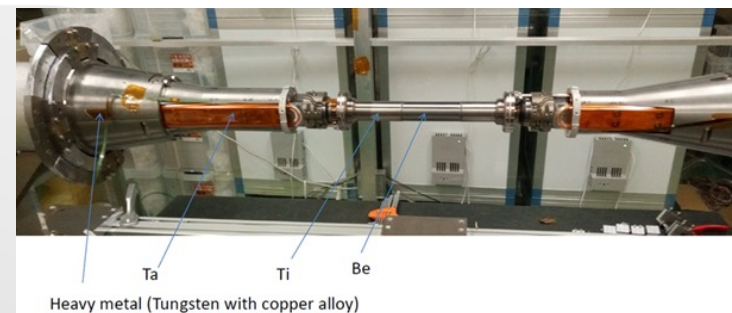
“Hot spot Issue”.

Temperature rise on the beam pipe elements near the IP region :
The observed temperature rise is about 10 degree with the current beam configuration, and is expected to increase substantially approaches to the nominal configuration.

Improving the cooling of this area is a very important action for a smooth operation of the Belle II experiment.

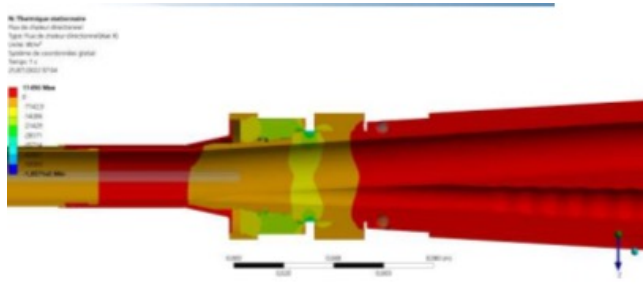
Solve the Hot Spot Issue, which will be the first goal of our partnership :

IJCLab team, guided by KEK mechanics experts and Belle-II vertex detector experts

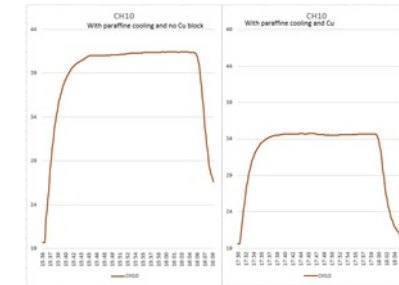
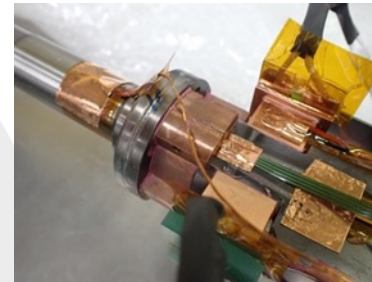


Proposed improvement :
Add thermal drain contact between
crotch and beam pipe.

- Perform a thermal analysis.
- Real beam pipe thermal test thermal drain efficiency.

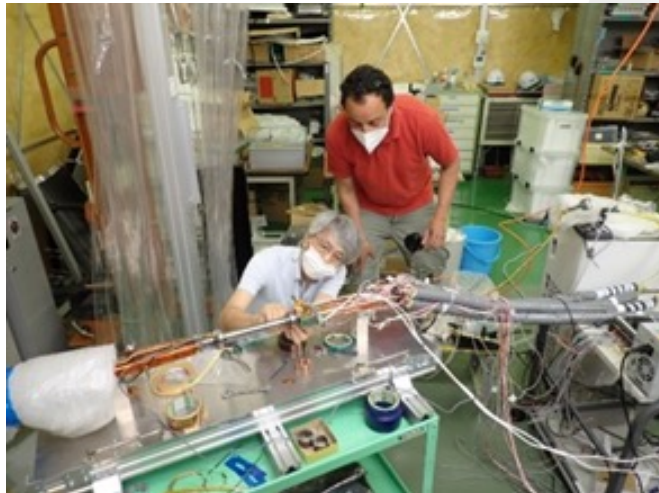


Latest FEM study of heat flow, demonstrating that the heat sink can evacuate the heat to the Beryllium beam pipe which is cooled by the paraffin.



Heat sink ring around the "hot spot" to contain the maximum temperature (left).
Heat sink ring around the "hot spot" to contain the maximum temperature (right).

Results obtained guided by the KEK experts
since October 2020



Thermal tests at KEK with an real beam pipe and The Tsukuba hall at KEK during IJCLab team's visit in July 2022.

Spring 2023

Right now !

Participation in the Removal of the VXD vertex detector
and beam pipe.



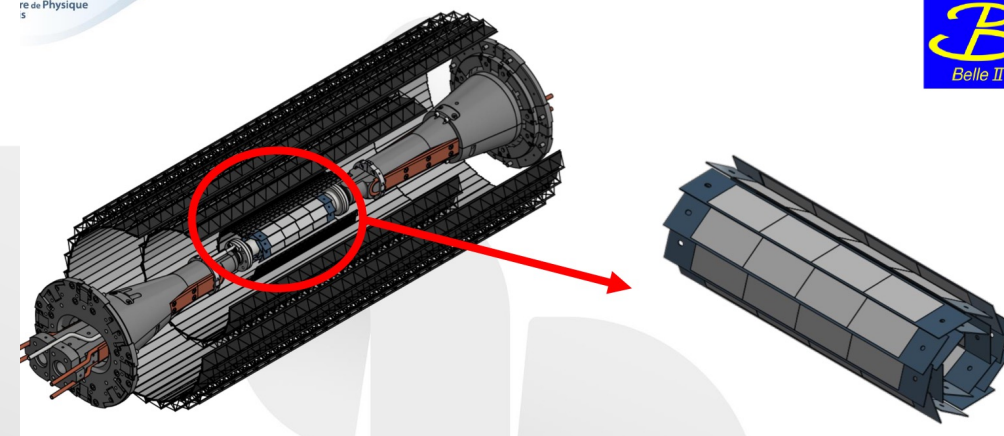
Knowledge and experience of IP region.

Beam pipe access and service for vertex detector.

Possible implication in the
2027 VTX upgrad.



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For a longer term, we plan to participate to the upgrade of 2027, the design of the new beam pipe and the study of the cooling for the next vertex detector cooling.

The acquired expertise and skills through this partnership can be further applied to future experiments, such as at a Higgs factory (e.g. ILC).

The cooperation will also reinforce the synergy between the research teams involved in perspective of the prominent role they may play in particularly challenging future projects such as an ultimate upgrade of the SuperKEKB machine or the ILC.

Cooperation with KEK may allow the IJCLab team to achieve an effective implementation of a component manufactured with additive manufacturing. For air cooling of the futur VTX for exemple.

The project itself also will serve as an educational framework. A mechanical design intern will work in June 2023 on defining an air cooling test bench for the first two layers of the future VTX detector..



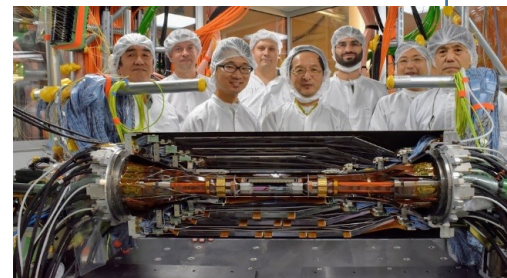
Travel between France and Japan. Stays for French members in Japan and for Japanese members in France.

The purposes of the visits

- Japanese team to visit France to have a better understanding of the facilities available at IJCLab.
- We may organise a mini-workshop for the occasion of the visit so that Japanese team can also meet other members of the IJCLab mechanics group (e.g. additive manufacturing).
- French team to visit KEK to advance the hot-spot works, test, installation, etc.
- We may organise a special meeting to discuss future collaborations for the 2027 upgrade of Belle II and further.

IR mechanics complex

- IP beam pipe: Inner design(Vacuum group), Outer design(IPNS-KEK), (IJClab)
- VXD mechanical base design: IPNS-KEK , Vacuum group, BG simulation
 - Heavy metal shields, Outer cover, End-flange, integration steps
- VXD mechanical integration: IPNS-KEK, (IJClab)
- PXD mechanical design: MPP, DESY
- SVD mechanical design: HEPHY, IPNS-KEK
- Diamond, VXD monitors: Trieste
- VXD installation: MPP, IPNS-KEK
- VXD service design: MPP, DSSY
- Bellows pipe: Vacuum group, DESY (IPNS-KEK)
- RVC: DESY, Vacuum group (IPNS-KEK)
- VXD cooling test: DESY



VXD mechanics group (S. Tanaka)
 First Combined VXD design(2011-2014)
Kohriki, Koike(BP, VXD srtructure),
Tscharlie(PXD), K. Gadow(PXD,BP),
F.Buchsteiner(SVD)

- Gap sensor btw. CDC and QCS: magnet group
- BPM@Bellows: monitor group
- QCS(final focus magnets): QCS group
- Paraffin cooling for IP pipe: IPNS-KEK
- Water cooling : Vacuum group
- CO2 cooling: MPP, KEK cryogenics group, (IPNS-KEK)
- BEAST sensors (CLAWS, FANG, PLUME, uTPC, He3, Pin-Diode, Plastic scintillator)
- BG simulation group (input for the mechanics design)
- CDC: IPNS-KEK

Name with underscore: machine group

Mai 2023: VXD disassembly

October 2023: New beam pipe thermal test and installation.