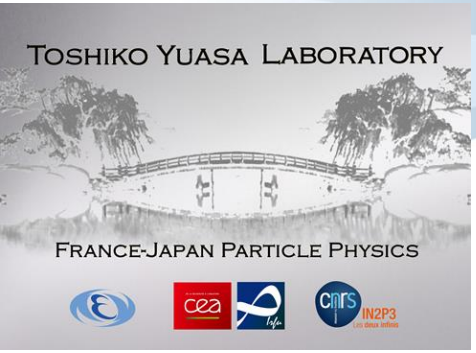


TYL – FJPPL Joint Workshop 2021 / D_RD_26

Staff Exchange

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

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

Didier Auguste
Julien Bonis
Emi Kou
Francois Le Diberder
Marc Winter

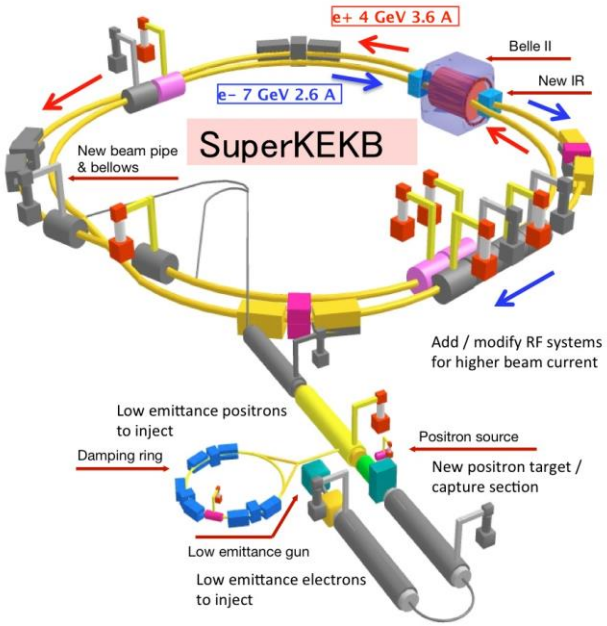
Takashi Kohriki
Katsuro Nakamura
Kyo Shibata
Shuji Tanaka
Shinji Terui

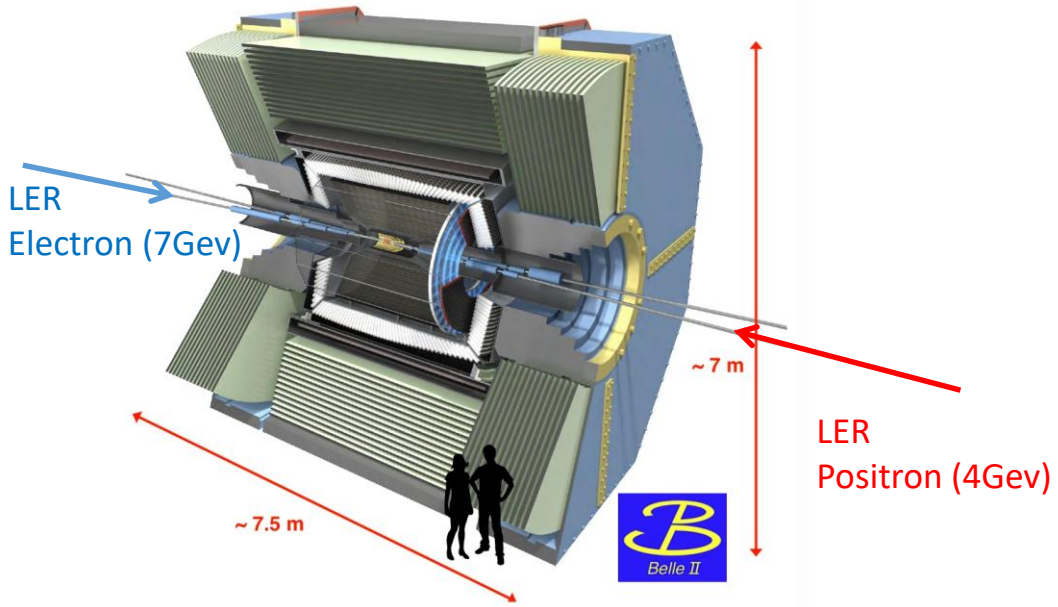
Mechanics of IP region at Belle II

- Introduction
- Project for 2021-2022
- Team contribution
- Long term
- Demand

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

Introduction





SuperKEKB : A Very high luminosity electron-positron collider.

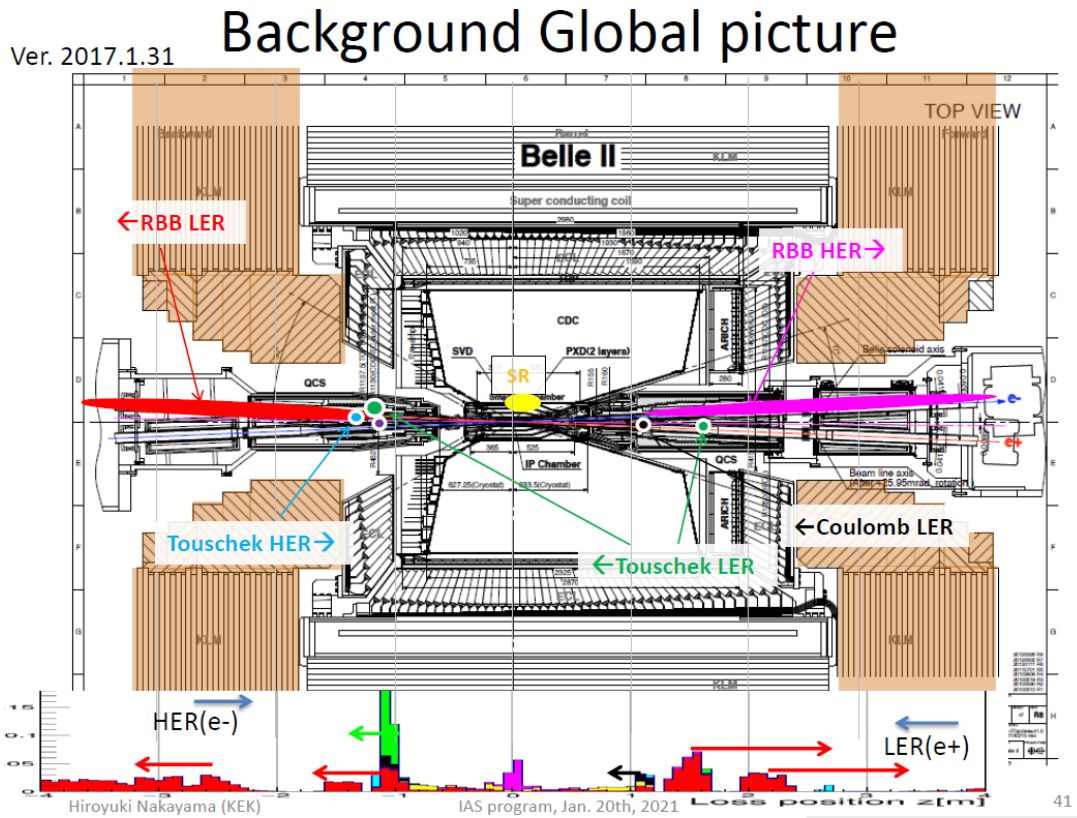
Innovative beam optics near the IP (Interaction Point) : Concept of high intensity nano-beams.

for

Study of fundamental properties of heavy quarks.

Quest for underlying BSM physics.

Introduction



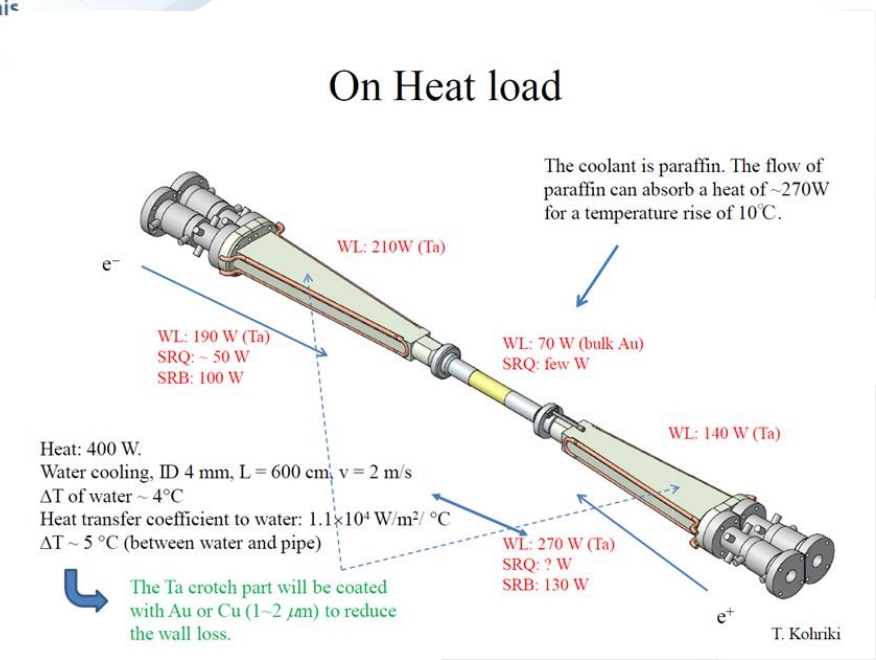
The goal of the partnership is to build up a comprehensive understanding of the mechanics of the beam pipe elements in the vicinity of the IP.

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 2022, while the next one is scheduled for 2026.

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

Project for 2021 - 2022



Japonese and french teams combined skills :

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

“Hot spot Issue”.

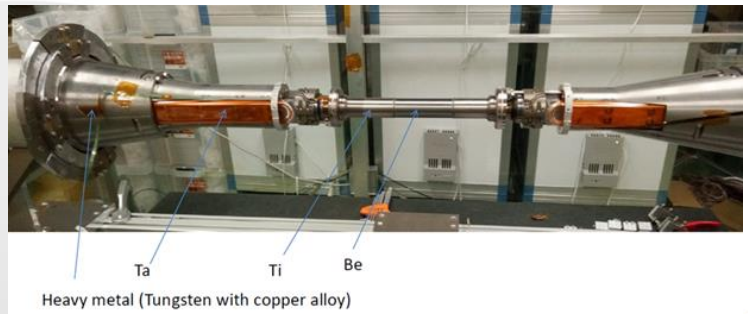
Temperature rise on the beam pipe elements near the IP region :

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.

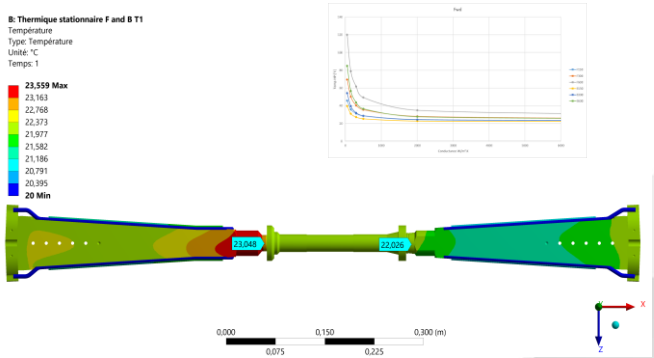
Solve the Hot Spot Issue, which will be the first goal of our partnership :

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

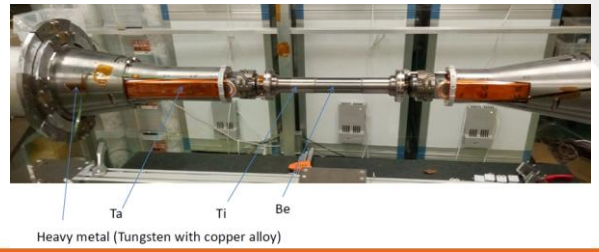


IJCLab Team contribution

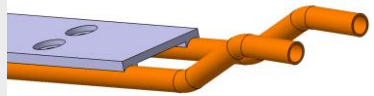
- Perform a thermal analysis.



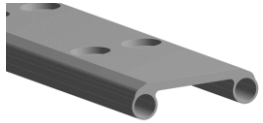
Crotchs and beam pipe Thermal simulation

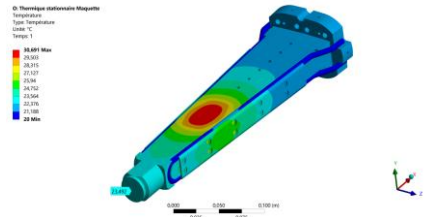


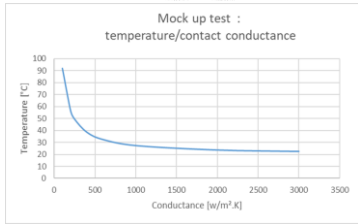
- Proposed improvement :
  Better thermal contact between cooling set up and crotch



- Mock up thermal test for prototype cooling set up.
  Conventional machining parts.
  Additive printing parts.





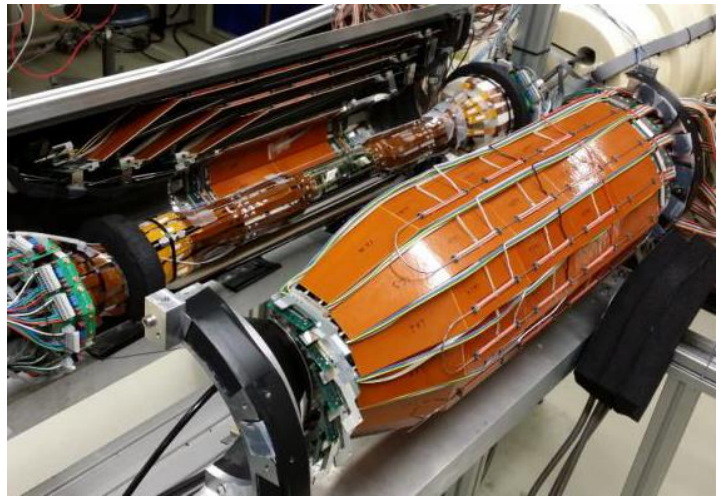


Results obtained guided by the KEK experts since October 2020

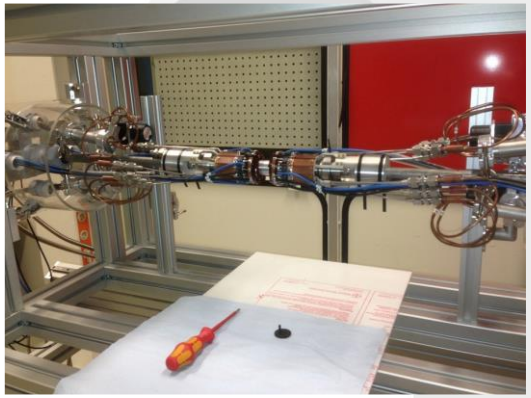
Complementary contribution

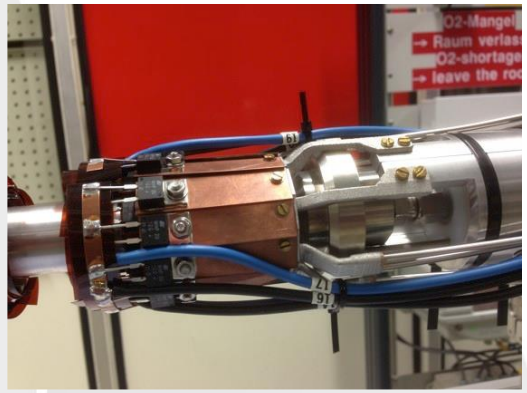
Summer 2022

Anticipation contribution :
Installation of innermost part of Belle II vertex detector layer



Knowledge and experience of IP region including additive fabrication cooling part.





Possible implication in the 2026 VXD upgrad.

Long term

For a longer term, we plan to participate to the upgrade of 2026, the design of the new beam pipe and possibly the mechanical integration of the vertex detector upgrade.

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.

The project itself also will serve as an educational framework where master and doctoral students will be introduced to fundamental aspects of machine related knowledge (e.g. Nano-beam technology) and their impact on the detector and its physics potential. Lectures on these topics may be arranged.

Demand for 2021

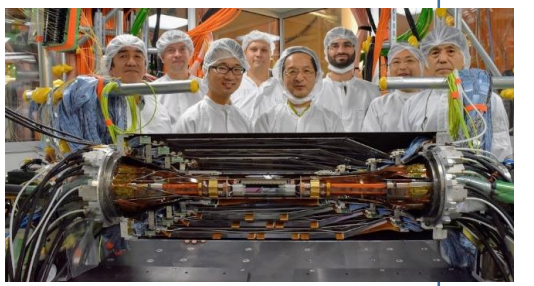
Travel between France and Japan.
One week stay for a French member in Japan
and a Japanese member in France.

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 2026 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
- Belle structure group : IPNS-KEK

Name with underscore: machine group

Provisional working plan

Jun 2021 : Cooling set-up test at IJCLab

Autumn 21 : Parts production, Japan visiting France (Covid ?).

Winter 21-22 : Shipping to KEK et acceptance test.

Summer 22 : installation, discutions for 2026