【International Leading Research】

Exploration of the particle physics frontier at the Super B-factory and cultivation of young researchers

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Purpose and Significance of the Research

● **"How did antimatters disappear from the Universe?" – Approaching the mystery with the world-leading accelerator experiment**

Elementary particles have **antiparticles** with reversed charges. Equal amounts of particles and antiparticles should have been produced from the enormous energy of the Big Bang, 13.8 billion years ago. However, the current universe is composed of matter (particles), and antimatter (antiparticles) is not found. Why? We are conducting research to approach this mystery with the **Super B-Factory (SuperKEKB/Belle II) experiment** at the High Energy Accelerator Research Organization (KEK) in Tsukuba.

We pioneered this research by discovering the particle and antiparticle asymmetry (**CP violation**) in the decay of B mesons at the KEK B factory experiment in 2001 and verifying the **Kobayashi-Maskawa theory**. However, the found asymmetry is too small, and a **new theory beyond the Standard Model** is required to answer the mystery.

We are now conducting the Super B-Factory experiment, which has greatly enhanced performance, to explore new physics (launched in 2019). The SuperKEKB accelerator is renewing the world's highest collision performance (luminosity) with the "**Nano-beam collision**" scheme. The Belle II experiment aims at collecting a large data sample of **B meson and τ lepton** decays, 50 times more than the previous KEKB/Belle experiment.

The purpose of this program is to ultimately improve the collision performance and potential of the experiment to find new physics by enhancing the cooperation of domestic and foreign researchers in Belle II, SuperKEKB, and theory working together. Our research will elucidate new physics and the mystery of the disappearing antimatter.

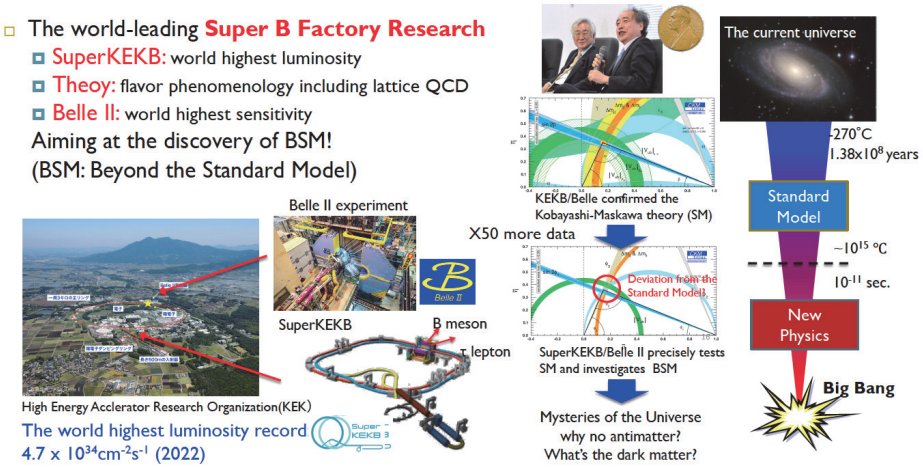

Fig.1 Particle physics research at the Super B-factory

Organization of the Project Team

● **World's leading international accelerator experiments hosted by Japan**

SuperKEKB/Belle II is one of the world's leading international accelerator projects, with more than 1,100 researchers from 27 countries and regions. KEK is responsible for the accelerator operation, whereas participating countries contribute to Belle II promotion (construction, operation, data analysis) with sub-detectors, funds, and computer resources. Toru Iijima is the Belle II spokesperson, and Japanese researchers are taking leading roles as the project manager, sub-detector, and data analysis group leaders.

● **Enhancing bidirectional research exchange with overseas research**

While the experiment is being conducted in Japan, the development of each sub-detector and data analysis are progressing worldwide. Our research program will create a flow from Japan to overseas and enhance two-way research exchange. The program is conducted by the PI (Toru Iijima) and 6 co-PIs. More than 10 young researchers and more than 10 graduate students will participate. From overseas, 18 researchers from 7 countries, including IJCLab, DESY, and CERN. Also, 18 researchers from Japanese research institutes collaborate to conduct research and to develop young researchers.

Fig.2 Belle II collaboration

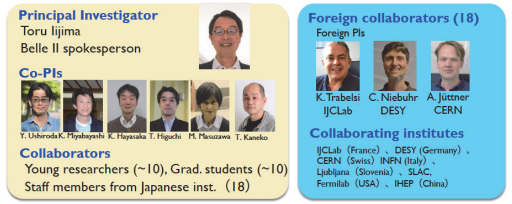

Fig.3 Organization of this research

Plan for Fostering Early-career Researchers

● **Fostering international leaders bonding experiments and accelerators, and experiments and theories**

For the future development of particle physics, it is important to enhance collaboration among experiments, accelerators, and theories, and cultivate young researchers who share those expertise and have a wealth of international experience. We conduct the cultivation programs; (1) **Postdoctoral fellowship:** could be stationed at a foreign partner institute, (2) **Overseas internship:** dispatch young researchers and graduate students to oversea partners (2 -6 months), (3) **Domestic internship:** train graduate students to learn new subjects (~ 3 months), (4) **Research project:** proposed and carried out by young researchers and students. Our program will develop young researchers who will be able to play a leading role in future international joint projects.

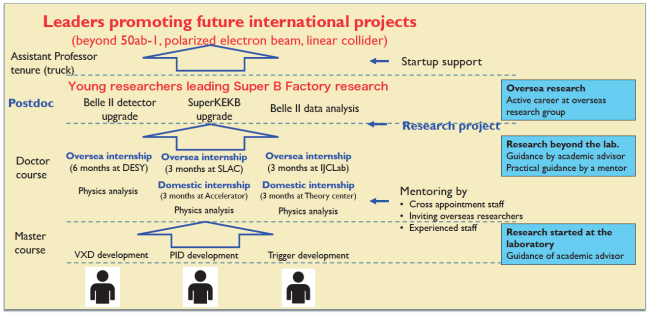

Fig.4 Cultivation program for leaders promoting future international projects

Homepage Address, etc.	https://belle2.org/, https://belle2.jp/, https://www.facebook.com/belle2collab/