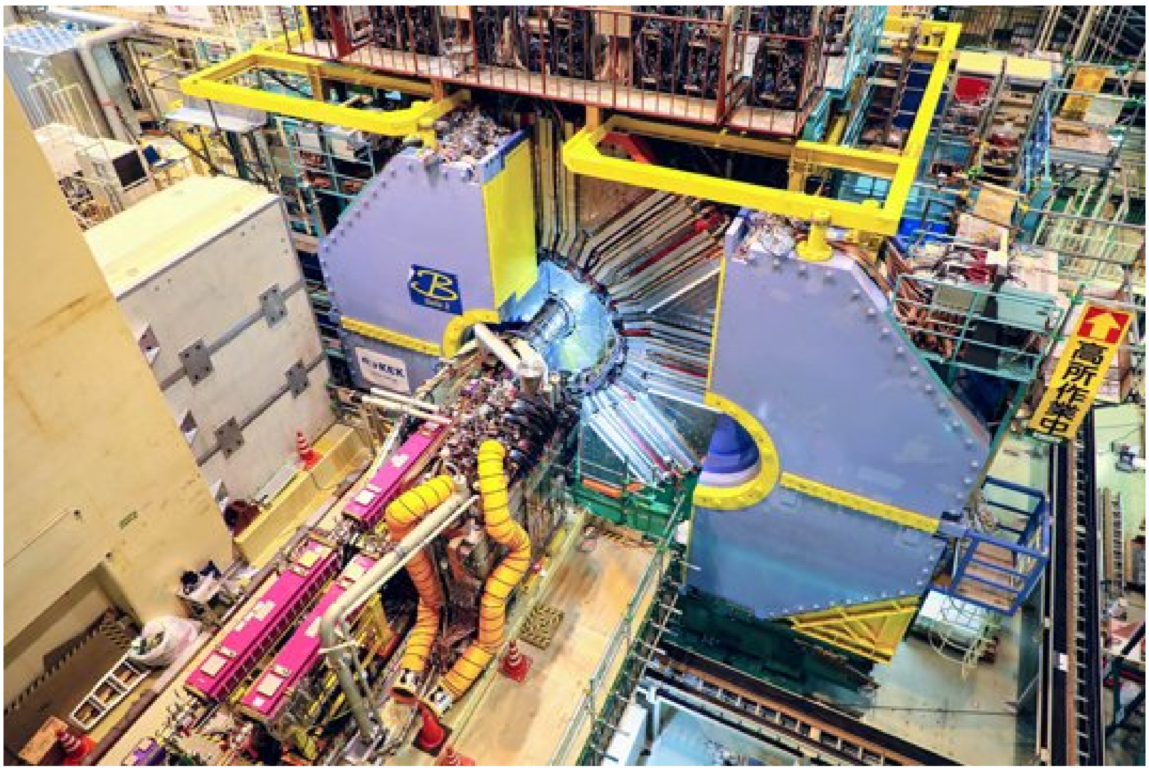
PHYS.ORG

Belle II measures first particle collisions

April 27 2018



The Belle II detector records and analyses particle collisions produced by SuperKEKB. Credit: Shota Takahashi/KEK

In the new SuperKEKB accelerator in Japan the first collisions of matter and anti-matter particles have been detected. Scientists from LMU and the Universe Cluster are involved in the experiments.

Particle physicists have been waiting for this moment for a long time: On 26 April 2018 at 0:38 GMT+09:00 at KEK (Japan's High Energy

Accelerator Research Organization) in Tsukuba, beams of matter and anti-matter particles collided for the first time in the new SuperKEKB accelerator. News of this success came from the detector, too: The Belle II instrument, which is also a new development, "saw" and recorded the particle tracks produced in the collision. Scientists hope the experiment will help them to understand why the original balanced ratio of matter to anti-matter in the Universe changed, so that it now contains virtually none of the latter.

What is the key to solving the matter/anti-matter mystery? Scientists are trying to find it in the decay patterns of short-lived particles, B-mesons in particular, where a slight excess of matter can be observed.

B-mesons are pairs of quarks with a particular characteristic: One of the two quarks is either a beauty (B-) quark or the corresponding antiparticle. B-mesons are produced when electrons and positrons (anti-electrons) collide and annihilate each other.

Search for special decays

SuperKEKB accelerates electrons and positrons circulating in opposite directions before they are brought into collision in the Belle II detector. Belle II records and analyzes the consequences of these collision events. "The particle tracks must be measured very precisely if we are to detect decays that deviate from the norm," explains Dr. Hans-Günther Moser from the Max Planck Institute for Physics (MPP). "This task falls to a high-sensitivity pixel detector, which is sited directly at the collision point in the center of Belle II." Prof. Dr. Thomas Kuhr from the LMU adds: "In addition to improved detectors, sophisticated algorithms are also required in order to find the smallest deviations when analyzing the large amounts of data recorded."

Eight years ago, upgrade measures began on the KEK accelerator and the

Belle detector in Tsukuba. The objective of this major project is to increase the previously attainable yield of B-mesons by a factor of 40: During the next 10 years, the SuperKEKB-Belle II combination is expected to produce and evaluate around 50 billion B-mesons. This enormous increase in the volume of data also enhances the chance of finding the sought-after decay pattern.

Scientists from LMU, the Excellence Cluster Universe, the Max Planck Institute of Physics and the Technical University of Munich (TUM) are involved in the construction of the innermost detector and in the development of the software for evaluating the data.

A ring accelerator on the home stretch

A crucial innovative feature of the SuperKEKB is a newly designed positron ring and a complex system of superconducting magnets that keep the particle bunches on track. The new Belle II detector, whose functions are perfectly matched to the facility, will be commissioned at the same time as the upgraded accelerator.

A few weeks ago, one electron and one positron beam were fed in. Since then, scientists and technical staff have been working to align the particle beams to the collision point inside the Belle II detector. Additionally, instruments built at the MPP are currently being used to measure background signals that would interfere with future analyses. After this test phase, the final components, including the pixel detector in whose development the MPP has played a crucial role, will be installed and calibrated. The current plan is for the scientific program to get underway early next year.

Provided by Ludwig Maximilian University of Munich