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Kaon Physics: present and future

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Kaon physics has been a source of many discoveries and was essential for the establishment of the Standard Model of particle physics as a viable theory of nature. In recent years the kaon physics community is concentrated on measuring the very rare $K \rightarrow \pi\nu\bar{\nu}$ decays, which are considered golden modes in flavour physics. The charged $K^+ \rightarrow \pi^+\nu\bar{\nu}$ decay mode is under investigation by the NA62 experiment at CERN. The NA62 experiment at CERN collected the world's largest dataset of charged kaon decays in 2016-2018 and restarted operation in 2021. NA62 will continue taking data until CERN Long Shutdown 3. The main goal is to measure the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ branching ratio with a precision of the order of 10%, but the large data set also allows for a wide variety of precision measurements of rare kaon decays as well as exotic searches for new particles.

The search for the neutral $K_L \rightarrow \pi^0\nu\bar{\nu}$ mode is currently being addressed by the KOTO experiment, located at the J-PARC accelerator complex in Japan. KOTO is expected to reach the SM sensitivity for the $K_L \rightarrow \pi^0\nu\bar{\nu}$ decay during the next decade.

The status of the NA62 and KOTO experiments will be presented, highlighting some of the latest physics results from the experiments.

The future availability of high-intensity kaon beams at the CERN SPS North Area gives rise to unique possibilities for sensitive tests of the Standard Model in the kaon sector. An overview of the physics goals, detector requirements, and project status for HIKE, the next generation of kaon physics experiments at CERN, will be presented.

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