Contribution ID: **155** Type: **not specified**

Experimental Study of Rare Kaon Decays at J-PARC with KOTO and KOTO II

The rare kaon decay $K_L \to \pi^0\nu\bar{\nu}$ is extremely sensitive to new physics, because the contribution to this decay in the Standard Model (SM) is highly suppressed and known very accurately; the branching ratio is 3×10^{-11} in the SM with a theoretical uncertainty of just 2\%. The measurement of this branching ratio could provide essential new information about the flavor structure of the quark sector
from the $s \to d$ transition.
The decay is being searched for in the KOTO experiment at J-PARC, which has obtained the current best upper limit on the branching ratio of 2.2×10^{-9}; a sensitivity to branching ratios below 10^{-10} is achievable by the end of the decade.
A next-generation experiment at J-PARC, KOTO˙II, was proposed in 2024 with 82 members worldwide, including significant contributions from European members. The goal of KOTO˙II is to measure the $K_L \to \pi^0\nu\bar{\nu}$ branching ratio with sensitivity below 10^{-12} in the 2030s. Discovery of the decay with 5σ significance is achievable at the SM value of the branching ratio. An indication of new physics with a significance of 90\% is possible if the observed branching ratio differs by 40\% from the SM value. Another important goal of KOTO˙II is to measure the branching ratio of the unobserved $K_L \to \pi^0 e^+ e^-$ decay, which can give an input to flavor structures of new physics. Other rare K_L decays and hidden-sector particles are also in the scope of the study.
After 2026, KOTO will be the only dedicated rare kaon decay experiment in the world, and KOTO˙II is the only future rare kaon decay project currently proposed. We would like to lead a global initiative for the experimental study of rare kaon decays, with significant contributions and support from the European community.

Authors: LAZZERONI, Cristina (University of Birmingham (GB)); NANJO, Hajime (Osaka University (JP)); MOULSON, Matthew (INFN e Laboratori Nazionali di Frascati (IT)); NOMURA, Tadashi; WAH, Yau