

# The search for $K_L \rightarrow \pi^0 \pi^0 X$ , $X \rightarrow \gamma\gamma$ in the KOTO experiment

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The KOTO experiment at J-PARC searches for the rare decay,  $K_L \rightarrow \pi^0 \nu \bar{\nu}$ . This search requires a high intensity  $K_L$  beam which sets KOTO in a unique position to probe sub-GeV quark coupling to dark matter. One avenue to study this is the mode  $K_L \rightarrow \pi^0 \pi^0 X$ , where  $X \rightarrow \gamma\gamma$ . This mode was studied in the E391a experiment at KEK in the  $X$  mass region 194.3-219.3 MeV, with the best upper limit on the branching ratio set with an  $X$  mass of 214.3 MeV at  $< 2.4 \times 10^{-7}$ . In KOTO, with an improved calorimeter and kaon flux, the single event sensitivity is improved by more than an order of magnitude in that mass range. In addition, the scope of the study is broadened to include the first search for  $K_L \rightarrow \pi^0 \pi^0 X$  with  $X$  mass in the range 155-190 MeV. I will present the results of the analysis on this mode using data collected in 2018 and 2021.

## Alternate track

1. Dark Matter Detection

## I read the instructions above

Yes

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**Session Classification:** Poster Session 2

**Track Classification:** 03. Beyond the Standard Model