

Physics beyond the SM with the NA62 experiment at CERN

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The NA62 experiment at CERN took data in 2016–2018 with the main goal of measuring the $K^+ \rightarrow \pi^+ \nu$ decay. The high-intensity setup and detector performance make NA62 particularly suited for searching new-physics effects from different scenarios involving feebly interacting particles in the MeV–GeV mass range. Searches for $K^+ \rightarrow e^+ N$, $K^+ \rightarrow \mu^+ N$ and $K^+ \rightarrow \mu^+ \nu X$ decays, where N and X are massive invisible particles, are performed by NA62. The N particle is assumed to be a heavy neutral lepton, and the results are expressed as upper limits of $O(10^{-8})$ of the neutrino mixing parameter $|U_{\mu 4}|^2$. The X particle is considered a scalar or vector hidden sector mediator decaying to an invisible final state. Upper limits of the decay branching fraction for X masses in the range 10–370 MeV/ c^2 are reported. An improved upper limit of 1.0×10^{-6} is established at 90% CL on the $K^+ \rightarrow \mu^+ \nu \nu$ branching fraction.

Dedicated trigger lines were employed to collect dilepton final states, which allowed establishing stringent upper limits on the rates lepton flavor and lepton number violating kaon decays. Upper limits on the rates of several K^+ decays violating lepton flavour and lepton number conservation, obtained by analysing this dataset, are presented.

The NA62 experiment can also be run as a beam-dump experiment, by removing the Kaon production target and moving the upstream collimators into a “closed” position. Analyses of the data taken in beam-dump mode were performed to search for visible decays of exotic mediators, with a particular emphasis on Dark Photon Models.

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