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Physics Beyond the Standard Model with NA62

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The NA62 experiment at CERN took data in 2016–2018 with the main goal of measuring the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ decay. The NA62 dataset is also exploited to search for light feebly interacting particles produced in kaon decays. 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/c² are reported. An improved upper limit of 1.0×10^{-6} is established at 90% CL on the $K^+ \rightarrow \mu^+ \nu \nu \nu$ branching fraction.

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

The NA62 experiment can be run as a “beam-dump experiment” by removing the Kaon production target and moving the upstream collimators into a “closed” position. More than 10^{17} protons on target have been collected in this way during a week-long data-taking campaign by the NA62 experiment. We report on the search for visible decays of exotic mediators from data taken in “beam-dump” mode, with a particular emphasis on Dark Photon and Axion-like particle Models.

Primary authors: ROMANO, Angela (University of Birmingham); SPEAKER, OTHER

Presenter: RAGGI, Mauro (Istituto Nazionale di Fisica Nucleare)

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