Contribution ID: **115**   Type: **not specified**

Searches for a feebly interacting particles at the NA62 experiment

Monday, 14 June 2021 18:20 (20 minutes)

The high-intensity setup and detector performance make the NA62 experiment at CERN particularly suited for searching new physics effects from different scenarios involving feebly interacting particles in the MeV-GeV mass range.

A search for the K+→π+X decay, where X is a long-lived feebly interacting particle, is performed through an interpretation of the K+→π+νν̄ analysis of data collected in 2016-2018. Model- dependent upper limits are obtained assuming X to be an axion-like particle with dominant fermion couplings or a dark scalar mixing with the Standard Model Higgs. Upper limits set on the branching ratio BR(K+→π+X) improve on current limits for mX below 260 MeV/c2 and rest lifetimes above 100 ps.

Searches for K+ → e+N, K+→μ+N and K+→μ+νX decays, where N and X are massive invisible particles, were performed by NA62 using the 2016-2018 data set.

The N particle is assumed to be a heavy neutral lepton, and the results are expressed as upper limits of $O(10^{-9})$ and $O(10^{-8})$ of the neutrino mixing parameter $|U_{e4}|^2$ and $|U_{\mu 4}|^2$, improving on the earlier searches for heavy neutral lepton production and decays in the kinematically accessible mass range. The X particle is considered a scalar or vector hidden sector mediator decaying to an invisible final state, and upper limits of the decay branching fraction for X masses in the range 10-370 MeV/c2 are reported for the first time, ranging from $O(10^{-5})$ to $O(10^{-7})$.

A study of a sample of 4×10^9 tagged π0 mesons from K+→π+π0(γ) is performed, searching for the decay of the π0 to invisible particles. No signal is observed in excess of the expected background fluctuations. An upper limit of 4.4×10^{-9} is set on the branching ratio at 90% C.L. improving on previous results by a factor of 60.

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Session Classification: Session 4