

New result from the NA64 experiment

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Thermal dark matter models with particle masses below the electroweak scale can provide an explanation for the observed relic dark matter density. This would imply the existence of a new feeble interaction between the dark and ordinary matter. The main purpose of the NA64 experiment is a search for sub-GeV dark matter production using the method of missing energy signature. The searches are performed at the H4 beam line at the CERN SPS. This beam is mainly designed to provide 100 GeV electron beam. The analysed statistics corresponds to 9.37×10^{11} electrons on target (EOT) collected during 2016-2022 runs. The analysis of this statistics allowed to probe for the first time the well motivated region of parameter space of benchmark thermal scalar and fermionic dark matter models. Additional statistics of about 6×10^{11} was collected in the 2023 run.

In addition to the main 100 GeV electron-beam measurement, NA64 is also developing a positron-beam program with several runs at different energies, to explore the ~ 100 MeV mediator mass range by exploiting LDM production via resonant e^+e^- annihilation. An early test run already demonstrated the feasibility of the new technique, allowing to set competitive new limits in a limited mass region despite the much lower accumulated statistics.

The variant of the NA64 detector for the searches of DM in the muon beam, called NA64mu, has been developed. It uses part of subdetectors of NA64e and a number of additional subdetectors. The purpose is to search for DM coupled only to second and third generations of leptons, suggested to explain the $(g-2)$ anomaly and to improve sensitivity in the region of mediator masses above ~ 300 MeV.

The program of searches for Dark Matter in hadron beams with slightly modified NA64 is been developed. Two test runs have been performed in 2022 and 2023, the analysis of the data is now in progress.

NA64 performed and plans also a number other searches, such as the search for ALP coupled to gammas, search for X boson decaying to electrons, search for mu - tau conversion.

Y. M. Andreev et al. (NA64 Collaboration), Phys. Rev. Lett. 131, 161801 (2023), arXiv:2307.02404 [hep-ex].

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