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Search for light Dark Sectors with the HIAF Muon Beam: HFRS-PKMu experiment proposal

Sub-GeV light dark matter usually requires the existence of new light mediators, such as the dark Z boson in the $L_{\mu} - L_{\tau}$ gauge theory. Here we study the search potential for such a Z' boson based on a muon on-target experiment proposal, through $\mu e^- \rightarrow \mu e^- X$, with X decays invisibly. The experimental signature would be scattered muon and electron from the target, at large angles compared to backgrounds. Apart from these, activities will be low in the subdetectors located downstream from the interaction point. Here we focus on the usage of the 1-10 GeV muon beam from the HIAF-HFRS facility which is expected to start operation in 2025-2026. Compared with existing experiments or proposals using the CERN 160 GeV muon beam, we find high sensitivity on 10 MeV Z' range.

Primary authors: ZHOU, Chen (Peking University); LIU, Cheng-en (Peking University); GAO, Leyun (Peking University); WANG, Zijian (北京大学); LI, Jinning (Peking University); LI, Qiang (Peking University); LI, Qite (Peking University); ZHANG, Xueheng (Institute of Modern Physics, Chinese Academy of Science); XU, Yu (Institute of Modern Physics, Chinese Academy of Science); SUN, Zhiyu (Institute of Modern Physics, CAS)

Presenter: WANG, Zijian (北京大学)