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Shedding light into the muon g-2 puzzle using a muon beam

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The long-standing mismatch between the measured muon magnetic moment and its Standard Model (SM) prediction (the so called (g-2)$_\mu$ anomaly) remains one of the most pressing questions in particle physics. Recently, the Muon g-2 Collaboration at Fermilab reported its latest results on the muon magnetic moment measurement. The combination of this measurement with the previous Brookhaven Muon g-2 experiment results compared to the updated theoretical value confirms a discrepancy of 4.2σ with respect to its SM prediction. There is an ongoing worldwide experimental and theoretical effort to elucidate this anomaly.

The existence of a sub-GeV Z'boson appearing as SM extension by gauging the difference of the lepton number between the muon and tau flavour, $L_\mu - L_\tau$, is one of the most appealing New Physics extensions to explain this anomaly. The g-2 discrepancy can be generated via 1-loop Z'contributions. Furthermore, the Z' can mediate a new interaction between the SM and Dark Matter (DM), explaining DM as a thermal-freeze out relic. Such a boson can be produced in the reaction of a high energy muon scattering off a nuclei via Dark Bremsstrahlung and searched for in missing energy events due to Z' decays either to neutrinos or DM particles. NA64$_\mu$ is a pioneer missing-energy experiment using the unique M2 muon high-energy and high-intensity beam-line at CERN Super Proton Synchrotron accelerator. A pilot run of the experiment took place in 2021 testing the feasibility of the technique, measuring for the first time the beam properties, the trigger rate and the reconstructed muon momentum at a low beam intensity. In 2022 the experiment will resume data taking. The results from both runs and the future prospects of the experiment to decisively demonstrate if the existence of a light Z'could explain this anomaly, will be discussed in this talk.

In-person participation

Yes

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