

Efficiency study of the displaced muon reconstruction for dark photon search with ATLAS detector

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There is currently an abundance of astrophysical evidence suggesting the existence of extra mass in the universe whose particle constituents cannot be explained by the Standard Model. Numerous theories were derived in an attempt to provide potential particle candidates for dark matter which are searched for by direct and indirect experiments. However, instead of focusing on finding a dark matter candidate, it can be easier to find a particle that mediates the interaction of dark matter and ordinary matter. One such particle, the dark photon, has been hypothesized to couple to the standard model particles through a mechanism called kinetic mixing at high energies. Two possible production modes for a high-mass dark photon are direct production and the HAHM both of which predict that a standard model particle can decay into a dark photon with a long lifetime which will undergo a significant distance unseen in the detector before decaying into two muons. Those muons provide a signature for dark photon production which can be accessed at extremely high energies. The Large Hadron Collider (LHC) provides access to interesting phase space in both models that cannot be probed any other way, while the ATLAS detector located at the LHC can be used to search for them. ATLAS is one of four main experiments at the LHC. It serves as a general multi-purpose detector that consists of tracking detectors, an energy calorimeter, and a muon spectrometer. The signature muons are expected to leave a trace in the silicon tracker layers and later a track in the muon spectrometer, the outermost layer of the detector. In this talk I present an ongoing analysis of the current run 3 data from the LHC to determine whether the ATLAS experiment can observe a long-lived dark photon decaying to muons with collaborators from the University of Oregon, Berkeley Lab, and Lund University. Specifically, efficiency studies of displaced muon reconstruction across the detector levels will be discussed.

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