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The Search for Dark Photons at the Short-Baseline Near Detector

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The low-energy excess anomaly seen in the MiniBooNE experiment has prompted the development of a plethora of physics scenarios and models. A noteworthy development in various dark sector models has recently shown promise in potentially offering explanation to the anomaly. This analysis focuses on the investigation of a rare three-body decay of charged mesons, and two-body decay of neutral mesons, via a newly proposed dark-sector gauge boson - the Dark Photon - at the Booster Neutrino Beam (BNB), as well as their decay and detection at the Short Baseline Near Detector (SBND). SBND is a 112 ton liquid argon time projection chamber detector located 110 m from the BNB target. The high intensity of the BNB as well as its proximity to SBND, makes the detector ideal for searching these dark sector models. We study the decay of neutral (π^0, η) and charged ($K^{\pm}$, $\pi^{\pm}$) mesons by two & three body decays, respectively, and through various approximations involving proton bremsstrahlung, to produce Dark Photons. We then focus on the detection of these dark photons at SBND through one of their decay channels: an electron-positron pair. Beginning with a basic truth-level event selection, employing various kinematic and timing cuts to understand initial signal efficiencies and purities, as well as estimating initial background rejection efficiencies, we determine how sensitive SBND is to Dark Photons.

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