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A Design of Hadronic Calorimeter for Dark SHINE Experiment

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The sensitivity of the dark photon search through invisible decay final states in low background experiments significantly relies on the neutron and muon veto efficiency, which depends on the amount of material used and the design of detector geometry. This paper presents an optimized design of a hadronic calorimeter (HCAL) used for the DarkSHINE experiment, which is studied using a GEANT4-based simulation framework. The geometry is optimized by comparing a traditional design with uniform absorbers to one that uses different thicknesses at different locations of the detector, which enhances the efficiency of vetoing low-energy neutrons at the sub-GeV level. The overall size and total amount of material used in HCAL are optimized to be lower due to the load and budget requirements, while the overall performance is studied to meet the physical objectives.

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