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Study of the optical properties of the scintillator strip – WLS fiber system for the AGORA muon detector

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The development of efficient and cost-effective muon detection systems is an important task for future circular lepton colliders such as CEPC and FCC-ee. Within the R&D program for the AGORA detector concept, a scintillator-based muon system with wavelength-shifting (WLS) fiber readout is being investigated. The performance of such a detector depends on the scintillator geometry, the method of WLS fiber integration, and the optical transport properties of the scintillator and fiber. In this report, experimental and Monte Carlo studies of scintillator strips with Kuraray Y-11 double-clad WLS fiber readout are presented. The light yield was measured for strips of various geometries to compare their optical performance. A dedicated study using extruded strips with 10×40 mm² cross sections from different manufacturers, with different fiber integration methods, determined the effective length of the WLS fiber segment where photon capture occurs, found to be approximately 4 cm — a result reproduced by an optical Monte Carlo model in good agreement with the experimental data. Monte Carlo simulations were also used to study the timing characteristics of photon propagation in double-clad Kuraray Y-11 WLS fibers, comparing 1 mm and 2 mm fiber diameters as well as straight and loop configurations. The obtained results characterize the influence of strip geometry, fiber integration methods, and fiber configuration on light collection and photon timing, providing experimental and simulation input for the optimization of scintillator strips and WLS fiber readout for the future AGORA muon system and other physics facilities.

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