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Study on positron contamination for the surface muon beamline at J-PARC

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The surface muon beamline at J-PARC delivers high-intensity muon beams essential for cutting-edge materials science research. However, positron contamination significantly impacts spectrometer measurements as a major source of noise. This study employs the G4 beamline Monte Carlo simulation toolkit to investigate positron contamination and develop mitigation strategies. Simulations track positron production at the muon target and their subsequent trajectories through the beamline, which includes a separator to achieve momentum and charge separation. A slit downstream reduces positron flux, but current configurations result in a 75% loss of muon beam intensity. To address this, we propose optimizing beam optics, including magnetic field configurations and slit geometry, to enhance charge separation efficiency and minimize muon loss. These advancements will improve beam quality and deliver high-purity muon beams for precision experiments, addressing critical challenges in beamline design and advancing the field of accelerator-based science.

Footnotes

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