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Comparison of Electron and Muon Interaction with Matter

The study compares the interactions of electrons and muons with matter, focusing on their energy loss mechanisms and penetration depth. Due to their low mass, electrons undergo significant energy losses through bremsstrahlung radiation and rapid scattering, which limits their penetration capability. In contrast, muons, being much heavier, primarily lose energy through ionization and can travel much deeper through various materials.
This distinction makes muons highly valuable in several applications, including space research, deep tomography, radiological security, and high-energy physics. The results of this study provide essential insights for the development of particle detection systems, radiation shielding technologies, and advanced imaging techniques using cosmic-ray muons.

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