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Preliminary Study of Muon Beam CT and Integration of MuDirac and Geant4 for Muonic X-ray Simulation

Muon beam imaging and muonic atom X-ray emission spectroscopy are two important techniques for multi-disciplinary applications of muon sources. Thanks to the strong penetrating power, imaging with cosmic-ray muons becomes a unique way to see through large objects. To investigate the possibility of imaging using muon beams in accelerator-based muon sources, we perform a simulation study of muon beam computed tomography with Geant4. In this report, the detector design and imaging results of muon beam CT are presented. Additionally, muonic X-rays emitted from the muonic atom cascade process can be used to investigate elemental components of bulk samples. However, the generation of Muonic X-rays in Geant4 has discrepancy with experimental results. A preliminary approach to solve this issue by integrating MuDirac, an open-source Dirac equation Solver, with Geant4 is presented. We discuss the development of Python scripts for generating a muonic X-ray database using MuDirac for various isotopes, as well as new Geant4 classes to manage the database.

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