Multiple Coulomb Scattering

Yuichi Okugawa

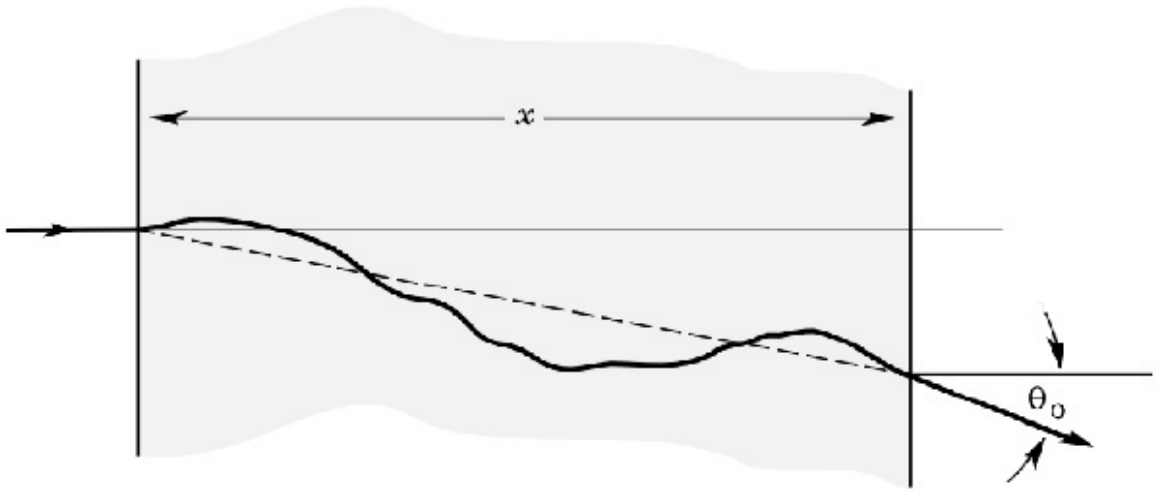
Tohoku University

okugawa@epx.phys.tohoku.ac.jp

July 4, 2018

Introduction

A charged particle traversing matter will be scattered by the Coulomb potentials of nuclei and electrons. In contrast to the ionisation energy loss which is caused by collisions with atomic electrons, multiple-scattering processes are dominated by deflections in the Coulomb field of nuclei. This leads to a large number of scattering processes with very low deviations from the original path.



Scattering-Angle Distribution

The root mean square of the projected scattering-angle distribution is given by:

$$\Theta_{rms}^{proj} = 13.6\text{MeV}\frac{z}{\beta cp}\sqrt{\frac{x}{X_0}}\left[1 + 0.038\ln\left(\frac{x}{X_0}\right)\right]$$

where p (in MeV/c) is the momentum, βc the velocity, and z the charge of the scattered particle. x/X_0 is the thickness of the scattering

$$X_0 = \frac{A}{4\alpha N_A Z^2 r_e^2 \ln(183Z^{-1/3})}$$

Radiation Length

Radiation Length:
Characteristic of a material, related to the energy loss of high energy, electromagnetic-interacting particles with it.