A toy model for simulating α particle emissions in p + 11B reactionns at K_p =10 MeV via Monte Carlo method

Angel Reina Ramirez, V. Magas

July 10, 2025

Contents

Abstract

We present a toy model for simulating α particle emissions in p+11B reactions at $K_p = 10$ MeV via Monte Carlo method. Incident proton is accelerated along the z-axes by an oscillating electric field of frequency ω, and its momentum is randomly generated at the moment of the collision. After collision we get an α particle, emitted in z-direction, and an excited 8Be nucleus at rest, which breaks down in two α particles emitted in opposite direction. Pseudorandom number generator Mersenne twister engine algorithm is employed to randomly spawn the emisson angles of α particles.

Chapter 1

Model description

Incident proton is accelerated along the z-axes by an oscillating electric field of a given frequency ω:

$$\boldsymbol{E} = (0, 0, E_0 cos(\omega t + \phi)). \tag{1.1}$$

From Newton's third law we get proton momentum:

$$F_z = eE_0 cos(\omega t + \phi) = \frac{dp_z}{dt}, \tag{1.2}$$

$$p_z = \frac{eE_0}{\omega} sin(\omega t + \phi) = p_{z,max} sin(\omega t + \phi), \tag{1.3}$$

where $p_{z,max} = \sqrt{2M_p K_p}$.

$\omega t + \phi$ angle is randomly generated via Mersenne twister engine algorithm at the time of the collision.

1.1 INITIAL STATE

1.1.1 GESRM

Appendix I